

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
12 July 2007 (12.07.2007)

PCT

(10) International Publication Number
WO 2007/079321 A2

(51) International Patent Classification:
G01R 23/00 (2006.01)

(21) International Application Number:
PCT/US2006/061852

(22) International Filing Date:
11 December 2006 (11.12.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/754,556 28 December 2005 (28.12.2005) US

(71) Applicant (for all designated States except US): **ENVEN-
TURE GLOBAL TECHNOLOGY, L.L.C.** [US/US];
15995 North Barkers Landing, Suite 350, Houston, Texas
77079 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **BRISCO, David
Paul** [US/US]; 405 Westridge Drive, Duncan, Oklahoma

73533 (US). **WATSON, Brock Wayne** [US/US]; 2535
Marsh Lane, #1004, Carrollton, Texas 75006 (US).
TREECE, Harold Otis [US/US]; 213 Ridgcrest Drive,
Duncan, Oklahoma 73533 (US).

(74) Agents: **HAYNES AND BOONE, LLP** et al.; 901 Main
Street, Suite 3100, Dallas, Texas 75202 (US).

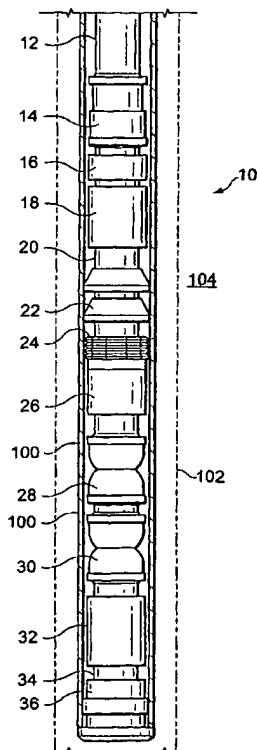
(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS,
JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS,
LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY,
MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS,
RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

[Continued on next page]

(54) Title: APPARATUS FOR RADIALY EXPANDING AND PLASTICALLY DEFORMING A TUBULAR MEMBER

(57) Abstract: An apparatus for radially expanding and plastically deforming a tubular member.



WO 2007/079321 A2



FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,
RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished
upon receipt of that report

Declaration under Rule 4.17:

— of inventorship (Rule 4.17(iv))

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

**APPARATUS FOR RADIALY EXPANDING AND PLASTICALLY DEFORMING A TUBULAR
MEMBER**

[0001] This application claims the benefit of the filing date of US provisional patent application serial number 60/754,556, attorney docket number 25791.342, filed on December 28, 2005, the disclosure of which is incorporated herein by reference.

[0002] The present application is a continuation-in-part of U.S. provisional patent application serial number 60/717391, attorney docket number 25791.214, filed on 9/15/2005, which was a continuation-in-part of PCT/US2004/011973, attorney docket number 25791.277.02, filed on 4/15/2004, the disclosures of which are incorporated herein by reference.

[0003] The present application is a continuation-in-part of the following: (1) PCT patent application serial number PCT/US02/36157, attorney docket number 25791.87.02, filed on 11/12/2002, (2) PCT patent application serial number PCT/US02/36267, attorney docket number 25791.88.02, filed on 11/12/2002, (3) PCT patent application serial number PCT/US03/04837, attorney docket number 25791.95.02, filed on 2/29/2003, (4) PCT patent application serial number PCT/US03/29859, attorney docket no. 25791.102.02, filed on 9/22/2003, (5) PCT patent application serial number PCT/US03/14153, attorney docket number 25791.104.02, filed on 11/13/2003, (6) PCT patent application serial number PCT/US03/18530, attorney docket number 25791.108.02, filed on 6/11/2003, (7) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, (8) PCT patent application serial number PCT/US03/29460, attorney docket number 25791.114.02, filed on 9/23/2003, filed on 9/22/2003, (9) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (10) PCT patent application serial number PCT/US04/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (11) PCT patent application serial number PCT/US04/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (12) PCT patent application serial number PCT/US04/010712, attorney docket number 25791.272.02, filed on 4/7/2004, (13) PCT patent application serial number PCT/US04/010762, attorney docket number 25791.273.02, filed on 4/6/2004, (14) PCT patent application serial number PCT/US04/011973, attorney docket number 25791.277.02, filed on 4/15/2004, and (15) U.S. provisional patent application serial number 60/717,391, attorney docket no. 25791.214, filed on 9/15/2005, the disclosures of which are incorporated herein by reference.

[0004] This application is related to the following co-pending applications: (1) U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (2) U.S. patent application serial no. 09/510,913, attorney docket no. 25791.7.02, filed on 2/23/2000, which claims priority from provisional application 60/121,702, filed on 2/25/99, (3) U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, which claims priority from provisional application 60/119,611, filed on 2/11/99, (4) U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (5) U.S. patent application serial no. 10/169,434, attorney docket no. 25791.10.04, filed on 7/1/02, which claims priority from provisional application 60/183,546, filed on 2/18/00, (6) U.S.

patent no. 6,640,903 which was filed as U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (7) U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (8) U.S. patent number 6,575,240, which was filed as patent application serial no. 09/511,941, attorney docket no. 25791.16.02, filed on 2/24/2000, which claims priority from provisional application 60/121,907, filed on 2/26/99, (9) U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (10) U.S. patent application serial no. 09/981,916, attorney docket no. 25791.18, filed on 10/18/01 as a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (11) U.S. patent number 6,604,763, which was filed as application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, which claims priority from provisional application 60/131,106, filed on 4/26/99, (12) U.S. patent application serial no. 10/030,593, attorney docket no. 25791.25.08, filed on 1/8/02, which claims priority from provisional application 60/146,203, filed on 7/29/99, (13) U.S. provisional patent application serial no. 60/143,039, attorney docket no. 25791.26, filed on 7/9/99, (14) U.S. patent application serial no. 10/111,982, attorney docket no. 25791.27.08, filed on 4/30/02, which claims priority from provisional patent application serial no. 60/162,671, attorney docket no. 25791.27, filed on 11/1/1999, (15) U.S. provisional patent application serial no. 60/154,047, attorney docket no. 25791.29, filed on 9/16/1999, (16) U.S. provisional patent application serial no. 60/438,828, attorney docket no. 25791.31, filed on 1/9/03, (17) U.S. patent number 6,564,875, which was filed as application serial no. 09/679,907, attorney docket no. 25791.34.02, on 10/5/00, which claims priority from provisional patent application serial no. 60/159,082, attorney docket no. 25791.34, filed on 10/12/1999, (18) U.S. patent application serial no. 10/089,419, filed on 3/27/02, attorney docket no. 25791.36.03, which claims priority from provisional patent application serial no. 60/159,039, attorney docket no. 25791.36, filed on 10/12/1999, (19) U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (20) U.S. patent application serial no. 10/303,992, filed on 11/22/02, attorney docket no. 25791.38.07, which claims priority from provisional patent application serial no. 60/212,359, attorney docket no. 25791.38, filed on 6/19/2000, (21) U.S. provisional patent application serial no. 60/165,228, attorney docket no. 25791.39, filed on 11/12/1999, (22) U.S. provisional patent application serial no. 60/455,051, attorney docket no. 25791.40, filed on 3/14/03, (23) PCT application US02/2477, filed on 6/26/02, attorney docket no. 25791.44.02, which claims priority from U.S. provisional patent application serial no. 60/303,711, attorney docket no. 25791.44, filed on 7/6/01, (24) U.S. patent application serial no. 10/311,412, filed on 12/12/02, attorney docket no. 25791.45.07, which claims priority from provisional patent application serial no. 60/221,443, attorney docket no. 25791.45, filed on 7/28/2000, (25) U.S. patent application serial no. 10/, filed on 12/18/02, attorney docket no. 25791.46.07, which claims

priority from provisional patent application serial no. 60/221,645, attorney docket no. 25791.46, filed on 7/28/2000, (26) U.S. patent application serial no. 10/322,947, filed on 1/22/03, attorney docket no. 25791.47.03, which claims priority from provisional patent application serial no. 60/233,638, attorney docket no. 25791.47, filed on 9/18/2000, (27) U.S. patent application serial no. 10/406,648, filed on 3/31/03, attorney docket no. 25791.48.06, which claims priority from provisional patent application serial no. 60/237,334, attorney docket no. 25791.48, filed on 10/2/2000, (28) PCT application US02/04353, filed on 2/14/02, attorney docket no. 25791.50.02, which claims priority from U.S. provisional patent application serial no. 60/270,007, attorney docket no. 25791.50, filed on 2/20/2001, (29) U.S. patent application serial no. 10/465,835, filed on 6/13/03, attorney docket no. 25791.51.06, which claims priority from provisional patent application serial no. 60/262,434, attorney docket no. 25791.51, filed on 1/17/2001, (30) U.S. patent application serial no. 10/465,831, filed on 6/13/03, attorney docket no. 25791.52.06, which claims priority from U.S. provisional patent application serial no. 60/259,486, attorney docket no. 25791.52, filed on 1/3/2001, (31) U.S. provisional patent application serial no. 60/452,303, filed on 3/5/03, attorney docket no. 25791.53, (32) U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (33) U.S. patent number 6,561,227, which was filed as patent application serial number 09/852,026, filed on 5/9/01, attorney docket no. 25791.56, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (34) U.S. patent application serial number 09/852,027, filed on 5/9/01, attorney docket no. 25791.57, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (35) PCT Application US02/25608, attorney docket no. 25791.58.02, filed on 8/13/02, which claims priority from provisional application 60/318,021, filed on 9/7/01, attorney docket no. 25791.58, (36) PCT Application US02/24399, attorney docket no. 25791.59.02, filed on 8/1/02, which claims priority from U.S. provisional patent application serial no. 60/313,453, attorney docket no. 25791.59, filed on 8/20/2001, (37) PCT Application US02/29856, attorney docket no. 25791.60.02, filed on 9/19/02, which claims priority from U.S. provisional patent application serial no. 60/326,886, attorney docket no. 25791.60, filed on 10/3/2001, (38) PCT Application US02/20256, attorney docket no. 25791.61.02, filed on 6/26/02, which claims priority from U.S. provisional patent application serial no. 60/303,740, attorney docket no. 25791.61, filed on 7/6/2001, (39) U.S. patent application serial no. 09/962,469, filed on 9/25/01, attorney docket no. 25791.62, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (40) U.S. patent application serial no. 09/962,470, filed on 9/25/01, attorney docket no. 25791.63, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on

3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (41) U.S. patent application serial no. 09/962,471, filed on 9/25/01, attorney docket no. 25791.64, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (42) U.S. patent application serial no. 09/962,467, filed on 9/25/01, attorney docket no. 25791.65, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (43) U.S. patent application serial no. 09/962,468, filed on 9/25/01, attorney docket no. 25791.66, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (44) PCT application US 02/25727, filed on 8/14/02, attorney docket no. 25791.67.03, which claims priority from U.S. provisional patent application serial no. 60/317,985, attorney docket no. 25791.67, filed on 9/6/2001, and U.S. provisional patent application serial no. 60/318,386, attorney docket no. 25791.67.02, filed on 9/10/2001, (45) PCT application US 02/39425, filed on 12/10/02, attorney docket no. 25791.68.02, which claims priority from U.S. provisional patent application serial no. 60/343,674, attorney docket no. 25791.68, filed on 12/27/2001, (46) U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, (now U.S. Patent 6,634,431 which issued 10/21/2003), which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (47) U.S. utility patent application serial no. 10/516,467, attorney docket no. 25791.70, filed on 12/10/01, which is a continuation application of U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, (now U.S. Patent 6,634,431 which issued 10/21/2003), which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (48) PCT application US 03/00609, filed on 1/9/03, attorney docket no. 25791.71.02, which claims priority from U.S. provisional patent application serial no. 60/357,372, attorney docket no. 25791.71, filed on 2/15/02, (49) U.S. patent application serial no. 10/074,703, attorney docket no. 25791.74, filed on 2/12/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (50) U.S. patent application serial no. 10/074,244, attorney docket no. 25791.75, filed on 2/12/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (51) U.S. patent application serial no. 10/076,660, attorney docket no. 25791.76, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from

provisional application 60/121,841, filed on 2/26/99, (52) U.S. patent application serial no. 10/076,661, attorney docket no. 25791.77, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (53) U.S. patent application serial no. 10/076,659, attorney docket no. 25791.78, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (54) U.S. patent application serial no. 10/078,928, attorney docket no. 25791.79, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (55) U.S. patent application serial no. 10/078,922, attorney docket no. 25791.80, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (56) U.S. patent application serial no. 10/078,921, attorney docket no. 25791.81, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (57) U.S. patent application serial no. 10/261,928, attorney docket no. 25791.82, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (58) U.S. patent application serial no. 10/079,276, attorney docket no. 25791.83, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (59) U.S. patent application serial no. 10/262,009, attorney docket no. 25791.84, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (60) U.S. patent application serial no. 10/092,481, attorney docket no. 25791.85, filed on 3/7/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (61) U.S. patent application serial no. 10/261,926, attorney docket no. 25791.86, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (62) PCT application US 02/36157, filed on 11/12/02, attorney docket no. 25791.87.02, which claims priority from U.S. provisional patent application serial no. 60/338,996, attorney docket no. 25791.87, filed on 11/12/01, (63) PCT application US 02/36267, filed on 11/12/02, attorney docket no. 25791.88.02, which claims priority from U.S. provisional patent application serial no. 60/339,013, attorney docket no. 25791.88, filed on 11/12/01, (64) PCT

application US 03/11765, filed on 4/16/03, attorney docket no. 25791.89.02, which claims priority from U.S. provisional patent application serial no. 60/383,917, attorney docket no. 25791.89, filed on 5/29/02, (65) PCT application US 03/15020, filed on 5/12/03, attorney docket no. 25791.90.02, which claims priority from U.S. provisional patent application serial no. 60/391,703, attorney docket no. 25791.90, filed on 6/26/02, (66) PCT application US 02/39418, filed on 12/10/02, attorney docket no. 25791.92.02, which claims priority from U.S. provisional patent application serial no. 60/346,309, attorney docket no. 25791.92, filed on 1/7/02, (67) PCT application US 03/06544, filed on 3/4/03, attorney docket no. 25791.93.02, which claims priority from U.S. provisional patent application serial no. 60/372,048, attorney docket no. 25791.93, filed on 4/12/02, (68) U.S. patent application serial no. 10/331,718, attorney docket no. 25791.94, filed on 12/30/02, which is a divisional U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (69) PCT application US 03/04837, filed on 2/29/03, attorney docket no. 25791.95.02, which claims priority from U.S. provisional patent application serial no. 60/363,829, attorney docket no. 25791.95, filed on 3/13/02, (70) U.S. patent application serial no. 10/261,927, attorney docket no. 25791.97, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (71) U.S. patent application serial no. 10/262,008, attorney docket no. 25791.98, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (72) U.S. patent application serial no. 10/261,925, attorney docket no. 25791.99, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (73) U.S. patent application serial no. 10/199,524, attorney docket no. 25791.100, filed on 7/19/02, which is a continuation of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (74) PCT application US 03/10144, filed on 3/28/03, attorney docket no. 25791.101.02, which claims priority from U.S. provisional patent application serial no. 60/372,632, attorney docket no. 25791.101, filed on 4/15/02, (75) U.S. provisional patent application serial no. 60/412,542, attorney docket no. 25791.102, filed on 9/20/02, (76) PCT application US 03/14153, filed on 5/6/03, attorney docket no. 25791.104.02, which claims priority from U.S. provisional patent application serial no. 60/380,147, attorney docket no. 25791.104, filed on 5/6/02, (77) PCT application US 03/19993, filed on 6/24/03, attorney docket no. 25791.106.02, which claims priority from U.S. provisional patent application serial no. 60/397,284, attorney docket no. 25791.106, filed on 7/19/02, (78) PCT application US 03/13787, filed on 5/5/03, attorney docket no. 25791.107.02, which claims priority from U.S. provisional patent application serial no. 60/387,486, attorney docket no. 25791.107, filed on 6/10/02, (79) PCT application US 03/18530, filed on 6/11/03, attorney docket no. 25791.108.02, which claims priority from U.S. provisional patent application serial no. 60/387,961, attorney docket

no. 25791.108, filed on 6/12/02, (80) PCT application US 03/20694, filed on 7/1/03, attorney docket no. 25791.110.02, which claims priority from U.S. provisional patent application serial no. 60/398,061, attorney docket no. 25791.110, filed on 7/24/02, (81) PCT application US 03/20870, filed on 7/2/03, attorney docket no. 25791.111.02, which claims priority from U.S. provisional patent application serial no. 60/399,240, attorney docket no. 25791.111, filed on 7/29/02, (82) U.S. provisional patent application serial no. 60/412,487, attorney docket no. 25791.112, filed on 9/20/02, (83) U.S. provisional patent application serial no. 60/412,488, attorney docket no. 25791.114, filed on 9/20/02, (84) U.S. patent application serial no. 10/280,356, attorney docket no. 25791.115, filed on 10/25/02, which is a continuation of U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (85) U.S. provisional patent application serial no. 60/412,177, attorney docket no. 25791.117, filed on 9/20/02, (86) U.S. provisional patent application serial no. 60/412,653, attorney docket no. 25791.118, filed on 9/20/02, (87) U.S. provisional patent application serial no. 60/405,610, attorney docket no. 25791.119, filed on 8/23/02, (88) U.S. provisional patent application serial no. 60/405,394, attorney docket no. 25791.120, filed on 8/23/02, (89) U.S. provisional patent application serial no. 60/412,544, attorney docket no. 25791.121, filed on 9/20/02, (90) PCT application US 03/24779, filed on 8/8/03, attorney docket no. 25791.125.02, which claims priority from U.S. provisional patent application serial no. 60/407,442, attorney docket no. 25791.125, filed on 8/30/02, (91) U.S. provisional patent application serial no. 60/423,363, attorney docket no. 25791.126, filed on 12/10/02, (92) U.S. provisional patent application serial no. 60/412,196, attorney docket no. 25791.127, filed on 9/20/02, (93) U.S. provisional patent application serial no. 60/412,187, attorney docket no. 25791.128, filed on 9/20/02, (94) U.S. provisional patent application serial no. 60/412,371, attorney docket no. 25791.129, filed on 9/20/02, (95) U.S. patent application serial no. 10/382,325, attorney docket no. 25791.145, filed on 3/5/03, which is a continuation of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (96) U.S. patent application serial no. 10/624,842, attorney docket no. 25791.151, filed on 7/22/03, which is a divisional of U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, which claims priority from provisional application 60/119,611, filed on 2/11/99, (97) U.S. provisional patent application serial no. 60/431,184, attorney docket no. 25791.157, filed on 12/5/02, (98) U.S. provisional patent application serial no. 60/448,526, attorney docket no. 25791.185, filed on 2/18/03, (99) U.S. provisional patent application serial no. 60/461,539, attorney docket no. 25791.186, filed on 4/9/03, (100) U.S. provisional patent application serial no. 60/462,750, attorney docket no. 25791.193, filed on 4/14/03, (101) U.S. provisional patent application serial no. 60/436,106, attorney docket no. 25791.200, filed on 12/23/02, (102) U.S. provisional patent application serial no. 60/442,942, attorney docket no. 25791.213, filed on 1/27/03, (103) U.S. provisional patent application serial no. 60/442,938, attorney docket no. 25791.225, filed on 1/27/03, (104) U.S. provisional patent application serial no. 60/418,687, attorney

docket no. 25791.228, filed on 4/18/03, (105) U.S. provisional patent application serial no. 60/454,896, attorney docket no. 25791.236, filed on 3/14/03, (106) U.S. provisional patent application serial no. 60/450,504, attorney docket no. 25791.238, filed on 2/26/03, (107) U.S. provisional patent application serial no. 60/451,152, attorney docket no. 25791.239, filed on 3/9/03, (108) U.S. provisional patent application serial no. 60/455,124, attorney docket no. 25791.241, filed on 3/17/03, (109) U.S. provisional patent application serial no. 60/453,678, attorney docket no. 25791.253, filed on 3/11/03, (110) U.S. patent application serial no. 10/421,682, attorney docket no. 25791.256, filed on 4/23/03, which is a continuation of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99, (111) U.S. provisional patent application serial no. 60/457,965, attorney docket no. 25791.260, filed on 3/27/03, (112) U.S. provisional patent application serial no. 60/455,718, attorney docket no. 25791.262, filed on 3/18/03, (113) U.S. patent number 6,550,821, which was filed as patent application serial no. 09/811,734, filed on 3/19/01, (114) U.S. patent application serial no. 10/436,467, attorney docket no. 25791.268, filed on 5/12/03, which is a continuation of U.S. patent number 6,604,763, which was filed as application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, which claims priority from provisional application 60/131,106, filed on 4/26/99, (115) U.S. provisional patent application serial no. 60/459,776, attorney docket no. 25791.270, filed on 4/2/03, (116) U.S. provisional patent application serial no. 60/461,094, attorney docket no. 25791.272, filed on 4/8/03, (117) U.S. provisional patent application serial no. 60/461,038, attorney docket no. 25791.273, filed on 4/7/03, (118) U.S. provisional patent application serial no. 60/463,586, attorney docket no. 25791.277, filed on 4/17/03, (119) U.S. provisional patent application serial no. 60/472,240; attorney docket no. 25791.286, filed on 5/20/03, (120) U.S. patent application serial no. 10/619,285, attorney docket no. 25791.292, filed on 7/14/03, which is a continuation-in-part of U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, (now U.S. Patent 6,634,431 which issued 10/21/2003), which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (121) U.S. utility patent application serial no. 10/418,688, attorney docket no. 25791.257, which was filed on 4/18/03, as a division of U.S. utility patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, (now U.S. Patent 6,640,903 which issued 11/4/2003), which claims priority from provisional application 60/124,042, filed on 3/11/99; (122) PCT patent application serial no. PCT/US2004/06246, attorney docket no. 25791.238.02, filed on 2/26/2004; (123) PCT patent application serial number PCT/US2004/08170, attorney docket number 25791.40.02, filed on 3/15/04; (124) PCT patent application serial number PCT/US2004/08171, attorney docket number 25791.236.02, filed on 3/15/04; (125) PCT patent application serial number PCT/US2004/08073, attorney docket number 25791.262.02, filed on 3/18/04; (126) PCT patent application serial number PCT/US2004/07711, attorney docket number 25791.253.02, filed on 3/11/2004; (127) PCT patent application serial number PCT/US2004/029025, attorney docket number 25791.260.02, filed on 3/26/2004; (128) PCT patent application serial number PCT/US2004/010317, attorney docket number

25791.270.02, filed on 4/2/2004; (129) PCT patent application serial number PCT/US2004/010712, attorney docket number 25791.272.02, filed on 4/6/2004; (130) PCT patent application serial number PCT/US2004/010762, attorney docket number 25791.273.02, filed on 4/6/2004; (131) PCT patent application serial number PCT/US2004/011973, attorney docket number 25791.277.02, filed on 4/15/2004; (132) U.S. provisional patent application serial number 60/495056, attorney docket number 25791.301, filed on 8/14/2003; (133) U.S. provisional patent application serial number 60/600679, attorney docket number 25791.194, filed on 8/11/2004; (134) PCT patent application serial number PCT/US2005/027318, attorney docket number 25791.329.02, filed on 7/29/2005; (135) PCT patent application serial number PCT/US2005/028936, attorney docket number 25791.338.02, filed on 8/12/2005; (136) PCT patent application serial number PCT/US2005/028669, attorney docket number 25791.194.02, filed on 8/11/2005; (137) PCT patent application serial number PCT/US2005/028453, attorney docket number 25791.371, filed on 8/11/2005; (138) PCT patent application serial number PCT/US2005/028641, attorney docket number 25791.372, filed on 8/11/2005; (139) PCT patent application serial number PCT/US2005/028819, attorney docket number 25791.373, filed on 8/11/2005; (140) PCT patent application serial number PCT/US2005/028446, attorney docket number 25791.374, filed on 8/11/2005; (141) PCT patent application serial number PCT/US2005/028642, attorney docket number 25791.375, filed on 8/11/2005; (142) PCT patent application serial number PCT/US2005/028451, attorney docket number 25791.376, filed on 8/11/2005, and (143) PCT patent application serial number PCT/US2005/028473, attorney docket number 25791.377, filed on 8/11/2005, (144) U.S. utility patent application serial number 10/546082, attorney docket number 25791.378, filed on 8/16/2005, (145) U.S. utility patent application serial number 10/546076, attorney docket number 25791.379, filed on 8/16/2005, (146) U.S. utility patent application serial number 10/545936, attorney docket number 25791.380, filed on 8/16/2005, (147) U.S. utility patent application serial number 10/546079, attorney docket number 25791.381, filed on 8/16/2005 (148) U.S. utility patent application serial number 10/545941, attorney docket number 25791.382, filed on 8/16/2005, (149) U.S. utility patent application serial number 546078, attorney docket number 25791.383, filed on 8/16/2005, filed on 8/11/2005., (150) U.S. utility patent application serial number 10/545941, attorney docket number 25791.185.05, filed on 8/16/2005, (151) U.S. utility patent application serial number 11/249967, attorney docket number 25791.384, filed on 10/13/2005, (152) U.S. provisional patent application serial number 60/734302, attorney docket number 25791.24, filed on 11/7/2005, (153) U.S. provisional patent application serial number 60/725181, attorney docket number 25791.184, filed on 10/11/2005, (154) PCT patent application serial number PCT/US2005/023391, attorney docket number 25791.299.02 filed 6/29/2005 which claims priority from U.S. provisional patent application serial number 60/585370, attorney docket number 25791.299, filed on 7/2/2004, (155) U.S. provisional patent application serial number 60/721579, attorney docket number 25791.327, filed on 9/28/2005, (156) U.S. provisional patent application serial number 60/717391, attorney docket number 25791.214, filed on 9/15/2005, (157) U.S. provisional patent application serial number 60/702935, attorney docket number 25791.133, filed on 7/27/2005, (158) U.S. provisional patent application serial number 60/663913, attorney docket number 25791.32, filed on 3/21/2005, (159) U.S. provisional patent application serial number 60/652564, attorney docket number 25791.348, filed on 2/14/2005,

(160) U.S. provisional patent application serial number 60/645840, attorney docket number 25791.324, filed on 1/21/2005, (161) PCT patent application serial number PCT/US2005/043122, attorney docket number 25791.326.02, filed on 11/29/2005 which claims priority from U.S. provisional patent application serial number 60/631703, attorney docket number 25791.326, filed on 11/30/2004, (162) U.S. provisional patent application serial number 60/752787, attorney docket number 25791.339, filed on 12/22/2005, (163) U.S. National Stage application serial no. 10/548934, attorney docket no. 25791.253.05, filed on 9/12/2005; (164) U.S. National Stage application serial no. 10/549410, attorney docket no. 25791.262.05, filed on 9/13/2005; (165) U.S. Provisional Patent Application No. 60/717391, attorney docket no. 25791.214 filed on 9/15/2005; (166) U.S. National Stage application serial no. 10/550906, attorney docket no. 25791.260.06, filed on 9/27/2005; (167) U.S. National Stage application serial no. 10/551880, attorney docket no. 25791.270.06, filed on 9/30/2005; (168) U.S. National Stage application serial no. 10/552253, attorney docket no. 25791.273.06, filed on 10/4/2005; (169) U.S. National Stage application serial no. 10/552790, attorney docket no. 25791.272.06, filed on 10/11/2005; (170) U.S. Provisional Patent Application No. 60/725181, attorney docket no. 25791.184 filed on 10/11/2005; (171) U.S. National Stage application serial no. 10/553094, attorney docket no. 25791.193.03, filed on 10/13/2005; (172) U.S. National Stage application serial no. 10/553566, attorney docket no. 25791.277.06, filed on 10/17/05; (173) PCT Patent Application No. PCT/US2006/002449, attorney docket no. 25791.324.02 filed on 1/20/06, (174) PCT Patent Application No. PCT/US2006/004809, attorney docket no. 25791.348.02 filed on 2/9/06; (175) U.S. Utility Patent application serial no. 11/356899, attorney docket no. 25791.386, filed on 2/17/06, (176) U.S. National Stage application serial no. 10/568200, attorney docket no. 25791.301.06, filed on 2/13/2006, (177) U.S. National Stage application serial no. 10/568719, attorney docket no. 25791.137.04, filed on 2/16/06, (178) U.S. National Stage application serial no. 10/569323, attorney docket no. 25791.215.06, filed on 2/17/06, (179) U.S. National State patent application serial no. 10/571041, attorney docket no. 25791.305.05, filed on 3/3/06; (180) U.S. National State patent application serial no. 10/571017, attorney docket no. 25791.306.04, filed on 3/3/06; (181) U.S. National State patent application serial no. 10/571086, attorney docket no. 25791.307.04, filed on 3/6/06; and (182) U.S. National State patent application serial no. 10/571085, attorney docket no. 25791.308.07, filed on 3/6/06, (183) U.S. utility patent application serial number 10/938788, attorney docket number 25791.330, filed on 9/10/04, (184) U.S. utility patent application serial number 10/938225, attorney docket number 25791.331, filed on 9/10/04, (185) U.S. utility patent application serial number 10/952288, attorney docket number 25791.332, filed on 9/28/04, (186) U.S. utility patent application serial number 10/952416, attorney docket number 25791.333, filed on 9/28/04, (187) U.S. utility patent application serial number 10/950749, attorney docket number 25791.334, filed on 9/27/04, (188) U.S. utility patent application serial number 10/950869, attorney docket number 25791.335, filed on 9/27/04; (189) U.S. provisional patent application serial number 60/761324, attorney docket number 25791.340, filed on 1/23/06, (190) U.S. provisional patent application serial number 60/754556, attorney docket number 25791.342, filed on 12/28/05, (191) U.S. utility patent application serial number 11/380051, attorney docket number 25791.388, filed on 4/25/06, (192) U.S. utility patent application serial number 11/380055, attorney docket number 25791.389, filed on

4/25/06, (193) U.S. utility patent application serial number 10/522039, attorney docket number 25791.106.05, filed on 3/10/2006; (194) U.S. provisional patent application serial number 60/746,813, attorney docket number 25791.259, filed on 5/9/2006; (195) U.S. utility patent application serial number 11/456584, attorney docket number 25791.403, filed on 7/11/2006; and (196) U.S. utility patent application serial number 11/456587, attorney docket number 25791.404, filed on 7/11/2006; (197) PCT Patent Application No. PCT/US2006/009886, attorney docket no. 25791.32.02 filed on 3/21/2006; (198) PCT Patent Application No. PCT/US2006/010674, attorney docket no. 25791.337.02 filed on 3/21/2006; (199) U.S. Patent 6,409,175 which issued 6/25/2002, attorney docket no. 25791.159; (200) U.S. Patent 6,550,821 which issued 4/22/2003, attorney docket no. 25791.263; (201) U.S. Patent Application No. 10/767,953, filed 1/29/2004, attorney docket no. 25791.309, now U.S. Patent 7077211 which issued 7/18/2006; (202) U.S. Patent Application No. 10/769,726, filed 1/30/2004, attorney docket no. 25791.310; (203) U.S. Patent Application No. 10/770363 filed 2/2/2004, attorney docket no. 25791.311; (204) U.S. utility patent application serial no. 11/068,595, attorney docket no. 25791.349, filed on 2/28/2005; (205) U.S. utility patent application serial no. 11/070,147, attorney docket no. 25791.351, filed on 3/2/2005; (206) U.S. utility patent application serial no. 11/071,409, attorney docket no. 25791.352, filed on 3/2/2005; (207) U.S. utility patent application serial no. 11/071,557, attorney docket no. 25791.353, filed on 3/3/2005; (208) U.S. utility patent application serial no. 11/072,578, attorney docket no. 25791.354, filed on 3/4/2005; (209) U.S. utility patent application serial no. 11/072,893, attorney docket no. 25791.355, filed on 3/4/2005; (210) U.S. utility patent application serial no. 11/072,594, attorney docket no. 25791.356, filed on 3/4/2005; (211) U.S. utility patent application serial no. 11/074,366, attorney docket no. 25791.357, filed on 3/7/2005; (212) U.S. utility patent application serial no. 11/074,266, attorney docket no. 25791.358, filed on 3/7/2005, (213) U.S. provisional patent application serial no. 60/832909, attorney docket no. 25791.407, filed on 7/24/2006, (214) U.S. utility patent application serial no. 11/536,302, attorney docket no. 25791.412, filed 9/28/2006, (215) U.S. utility patent application serial no. 11/538228, attorney docket no. 25791.156, filed 10/3/06, and (216) U.S. utility patent application serial no. 11/552,703, filed on October 25, 2006, attorney docket no. 25791.401, the disclosures of which are incorporated herein by reference.

Background of the Invention

[0005] This invention relates generally to oil and gas exploration, and in particular to forming and repairing wellbore casings to facilitate oil and gas exploration.

Brief Description of the Drawings

[0006] Fig. 1 is a fragmentary cross-sectional illustration of an embodiment of a system for radially expanding and plastically deforming wellbore casing, including a tubular support member, a casing cutter, a ball gripper for gripping a wellbore casing, a force multiplier tension actuator, a safety sub, a cup sub, a casing lock, an extension actuator, a bell section adjustable expansion cone assembly, a casing section adjustable expansion cone assembly, a packer setting tool, a packer, a stinger, and an expandable wellbore casing, during the placement of the system within a wellbore.

[0007] Fig. 2 is a fragmentary cross-sectional illustration of the system of Fig. 1 during the subsequent displacement of the bell section adjustable expansion cone assembly, the casing section

adjustable expansion cone assembly, the packer setting tool, the packer, and the stinger downwardly out of the end of the expandable wellbore casing and the expansion of the size of the bell section adjustable expansion cone assembly and the casing section adjustable expansion cone assembly.

[0008] Fig. 3 is a fragmentary cross-sectional illustration of the system of Fig. 2 during the subsequent operation of the tension actuator to displace the bell section adjustable expansion cone assembly upwardly into the end of the expandable wellbore casing to form a bell section in the end of the expandable wellbore casing.

[0009] Fig. 4 is a fragmentary cross-sectional illustration of the system of Fig. 3 during the subsequent reduction of the bell section adjustable expansion cone assembly.

[0010] Fig. 5 is a fragmentary cross-sectional illustration of the system of Fig. 4 during the subsequent upward displacement of the expanded casing section adjustable expansion cone assembly to radially expand the expandable wellbore casing.

[0011] Fig. 6 is a fragmentary cross-sectional illustration of the system of Fig. 5 during the subsequent lowering of the tubular support member, casing cutter, ball gripper, a force multiplier tension actuator, safety sub, cup sub, casing lock, extension actuator, bell section adjustable expansion cone assembly, casing section adjustable expansion cone assembly, packer setting tool, packer, and stinger and subsequent setting of the packer within the expandable wellbore casing above the bell section.

[0012] Fig. 7 is a fragmentary cross-sectional illustration of the system of Fig. 6 during the subsequent injection of fluidic materials into the system to displace the expanded casing section adjustable expansion cone assembly upwardly through the expandable wellbore casing to radially expand and plastically deform the expandable wellbore casing.

[0013] Fig. 8 is a fragmentary cross-sectional illustration of the system of Fig. 7 during the subsequent injection of fluidic materials into the system to displace the expanded casing section adjustable expansion cone assembly upwardly through the expandable wellbore casing and a surrounding preexisting wellbore casing to radially expand and plastically deform the overlapping expandable wellbore casing and the surrounding preexisting wellbore casing.

[0014] Fig. 9 is a fragmentary cross-sectional illustration of the system of Fig. 8 during the subsequent operation of the casing cutter to cut off an end of the expandable wellbore casing.

[0015] Fig. 10 is a fragmentary cross-sectional illustration of the system of Fig. 9 during the subsequent removal of the cut off end of the expandable wellbore casing.

[0016] Figs. 13A1 to 13A8 and 13B1 to 13B7 are fragmentary cross-sectional illustrations of an exemplary embodiment of a tension actuator assembly.

[0017] Fig. 34 is an elevational view of another exemplary embodiment of a tension actuator assembly.

[0018] Figs. 35A to 35C is a fragmentary cross-sectional illustration of an exemplary embodiment of a lower subassembly of the tension actuator assembly of Fig. 34.

[0019] Figs. 36A to 36C is a fragmentary cross-sectional illustration of an exemplary embodiment of a middle subassembly of the tension actuator assembly of Fig. 34.

- [00020] Figs. 37A to 37C is a fragmentary cross-sectional illustration of an exemplary embodiment of an upper subassembly of the tension actuator assembly of Fig. 34.
- [00021] Figs. 38A and 38B is a fragmentary cross-sectional illustration of an exemplary embodiment of a top subassembly of the tension actuator assembly of Fig. 34.
- [00022] Figs. 39A to 39T, 40A to 40T and 41A to 41X, are fragmentary cross-sectional illustrations of an exemplary embodiment of the operation of the tension actuator assembly of Fig. 34.
- [00023] Figs. 42A and 42B are respective elevational and cross-sectional views of an exemplary embodiment of a device adapted to be coupled to, for example, one or more subassemblies of the tension actuator assembly of Fig. 34.
- [00024] Fig. 43 is a cross-sectional illustration of the exemplary embodiment of the device of Figs. 42A and 42B coupled to the middle subassembly of Figs. 36A to 36C.
- [00025] Fig. 44 is a cross-sectional illustration of the exemplary embodiment of the device of Figs. 42A and 42B coupled to the upper subassembly of Figs. 37A to 37C.

Detailed Description of the Illustrative Embodiments

- [00026] Referring initially to Figs. 1-10, an exemplary embodiment of a system 10 for radially expanding and plastically deforming a wellbore casing includes a conventional tubular support 12 having an end that is coupled to an end of a casing cutter assembly 14. In an exemplary embodiment, the casing cutter assembly 14 may be, or may include elements, of one or more conventional commercially available casing cutters for cutting wellbore casing, or equivalents thereof.
- [00027] An end of a ball gripper assembly 16 is coupled to another end of the casing cutter assembly 14. In an exemplary embodiment, the ball gripper assembly 14 may be, or may include elements, of one or more conventional commercially available ball grippers, or other types of gripping devices, for gripping wellbore casing, or equivalents thereof.
- [00028] An end of a tension actuator assembly 18 is coupled to another end of the ball gripper assembly 16. In an exemplary embodiment, the tension actuator assembly 18 may be, or may include elements, of one or more conventional commercially actuators, or equivalents thereof.
- [00029] An end of a safety sub assembly 20 is coupled to another end of the tension actuator assembly 18. In an exemplary embodiment, the safety sub assembly 20 may be, or may include elements, of one or more conventional apparatus that provide quick connection and/or disconnection of tubular members, or equivalents thereof.
- [00030] An end of a sealing cup assembly 22 is coupled to another end of the safety sub assembly 20. In an exemplary embodiment, the sealing cup assembly 22 may be, or may include elements, of one or more conventional sealing cup assemblies, or other types of sealing assemblies, that sealingly engage the interior surfaces of surrounding tubular members, or equivalents thereof.
- [00031] An end of a casing lock assembly 24 is coupled to another end of the sealing cup assembly 22. In an exemplary embodiment, the casing lock assembly 24 may be, or may include elements, of one or more conventional casing lock assemblies that lock the position of wellbore casing, or equivalents thereof.
- [00032] An end of an extension actuator assembly 26 is coupled to another end of the casing lock

assembly 24. In an exemplary embodiment, the extension actuator assembly 26 may be, or may include elements, of one or more conventional actuators, or equivalents thereof.

[00033] An end of an adjustable bell section expansion cone assembly 28 is coupled to another end of the extension actuator assembly 26. In an exemplary embodiment, the adjustable bell section expansion cone assembly 28 may be, or may include elements, of one or more conventional adjustable expansion devices for radially expanding and plastically deforming wellbore casing, or equivalents thereof.

[00034] An end of an adjustable casing expansion cone assembly 30 is coupled to another end of the adjustable bell section expansion cone assembly 28. In an exemplary embodiment, the adjustable casing expansion cone assembly 30 may be, or may include elements, of one or more conventional adjustable expansion devices for radially expanding and plastically deforming wellbore casing, or equivalents thereof.

[00035] An end of a packer setting tool assembly 32 is coupled to another end of the adjustable casing expansion cone assembly 30. In an exemplary embodiment, the packer setting tool assembly 32 may be, or may include elements, of one or more conventional adjustable expansion devices for controlling the operation of a conventional packer, or equivalents thereof.

[00036] An end of a stinger assembly 34 is coupled to another end of the packer setting tool assembly 32. In an exemplary embodiment, the stinger assembly 34 may be, or may include elements, of one or more conventional devices for engaging a conventional packer, or equivalents thereof.

[00037] An end of a packer control device or packer assembly 36 is coupled to another end of the stinger assembly 34. In an exemplary embodiment, the packer assembly 36 may be, or may include elements, of one or more conventional packers.

[00038] In an exemplary embodiment, one or more of the elements of the system 10 may be omitted, at least in part, and/or combined, at least in part, with one or more of the other elements of the system.

[00039] As illustrated in Fig. 1, in an exemplary embodiment, during operation of the system 10, an expandable wellbore casing 100 is coupled to and supported by the casing lock assembly 24 of the system. The system 10 is then positioned within a wellbore 102 that traverses a subterranean formation 104 and includes a preexisting wellbore casing 106.

[00040] As illustrated in Fig. 2, in an exemplary embodiment, the extension actuator assembly 26 is then operated to move the adjustable bell section expansion cone assembly 28, adjustable casing expansion cone assembly 30, packer setting tool assembly 32, stinger assembly 34, packer assembly 36 downwardly in a direction 108 and out of an end of the expandable wellbore casing 100. After the adjustable bell section expansion cone assembly 28 and adjustable casing expansion cone assembly 30 have been moved to a position out of the end of the expandable wellbore casing 100, the adjustable bell section expansion cone assembly and adjustable casing expansion cone assembly are then operated to increase the outside diameters of the expansion cone assemblies. In an exemplary embodiment, the increased outside diameter of the adjustable bell section expansion cone assembly 28 is greater than the increased outside diameter of the adjustable casing expansion cone assembly

30.

[00041] As illustrated in Fig. 3, in an exemplary embodiment, the ball gripper assembly 16 is then operated to engage and hold the position of the expandable tubular member 100 stationary relative to the tubular support member 12. The tension actuator assembly 18 is then operated to move the adjustable bell section expansion cone assembly 28, adjustable casing expansion cone assembly 30, packer setting tool assembly 32, stinger assembly 34, packer assembly 36 upwardly in a direction 110 into and through the end of the expandable wellbore casing 100. As a result, the end of the expandable wellbore casing 100 is radially expanded and plastically deformed by the adjustable bell section expansion cone assembly 28 to form a bell section 112. In an exemplary embodiment, during the operation of the system 10 described above with reference to Fig. 3, the casing lock assembly 24 may or may not be coupled to the expandable wellbore casing 100.

[00042] In an exemplary embodiment, the length of the end of the expandable wellbore casing 100 that is radially expanded and plastically deformed by the adjustable bell section expansion cone assembly 28 is limited by the stroke length of the tension actuator assembly 18. In an exemplary embodiment, once the tension actuator assembly 18 completes a stroke, the ball gripper assembly 16 is operated to release the expandable tubular member 100, and the tubular support 12 is moved upwardly to permit the tension actuator assembly to be re-set. In this manner, the length of the bell section 112 can be further extended by continuing to stroke and then re-set the position of the tension actuator assembly 18. Note, that, during the upward movement of the tubular support 12 to re-set the position of the tension actuator assembly 18, the expandable tubular wellbore casing 100 is supported by the expansion surfaces of the adjustable bell section expansion cone assembly 28.

[00043] As illustrated in Fig. 4, in an exemplary embodiment, the casing lock assembly 24 is then operated to engage and maintain the position of the expandable wellbore casing 100 stationary relative to the tubular support 12. The adjustable bell section expansion cone assembly 28, adjustable casing expansion cone assembly 30, packer setting tool assembly 32, stinger assembly 34, and packer assembly 36 are displaced downwardly into the bell section 112 in a direction 114 relative to the expandable wellbore casing 100 by operating the extension actuator 26 and/or by displacing the system 10 downwardly in the direction 114 relative to the expandable wellbore casing. After the adjustable bell section expansion cone assembly 28 and adjustable casing expansion cone assembly 30 have been moved downwardly in the direction 114 into the bell section 112 of the expandable wellbore casing 100, the adjustable bell section expansion cone assembly is then operated to decrease the outside diameter of the adjustable bell section expansion cone assembly. In an exemplary embodiment, the decreased outside diameter of the adjustable bell section expansion cone assembly 28 is less than the increased outside diameter of the adjustable casing expansion cone assembly 30. In an exemplary embodiment, during the operation of the system illustrated and described above with reference to Fig. 4, the ball gripper 16 may or may not be operated to engage the expandable wellbore casing 100.

[00044] As illustrated in Fig. 5, in an exemplary embodiment, the casing lock assembly 24 is then disengaged from the expandable wellbore casing 100 and fluidic material 116 is then injected into the system 10 through the tubular support 12 to thereby pressurize an annulus 118 defined within the

expandable wellbore casing below the cup sub assembly 22. As a result, a pressure differential is created across the cup seal assembly 22 that causes the cup seal assembly to apply a tensile force in the direction 120 to the system 10. As a result, the system 10 is displaced upwardly in the direction 120 relative to the expandable wellbore casing 100 thereby pulling the adjustable casing expansion cone assembly 30 upwardly in the direction 120 through the expandable wellbore casing thereby radially expanding and plastically deforming the expandable wellbore casing.

[00045] In an exemplary embodiment, the tension actuator assembly 16 may also be operated during the injection of the fluidic material 116 to displace the adjustable casing expansion cone assembly 30 upwardly relative to the tubular support 12. As a result, additional expansion forces may be applied to the expandable wellbore casing 100.

[00046] As illustrated in Fig. 6, in an exemplary embodiment, the radial expansion and plastic deformation of the expandable wellbore casing using the adjustable casing expansion cone assembly 30 continues until the packer assembly 36 is positioned within a portion of the expandable tubular member above the bell section 112. The packer assembly 36 may then be operated to engage the interior surface of the expandable wellbore casing 100 above the bell section 112.

[00047] In an exemplary embodiment, after the packer assembly 36 is operated to engage the interior surface of the expandable wellbore casing 100 above the bell section 112, a hardenable fluidic sealing material 122 may then be injected into the system 10 through the tubular support 12 and then out of the system through the packer assembly to thereby permit the annulus between the expandable wellbore casing and the wellbore 102 to be filled with the hardenable fluidic sealing material. The hardenable fluidic sealing material 122 may then be allowed to cure to form a fluid tight annulus between the expandable wellbore casing 100 and the wellbore 102, before, during, or after the completion of the radial expansion and plastic deformation of the expandable wellbore casing.

[00048] As illustrated in Fig. 7, in an exemplary embodiment, the fluidic material 116 is then re-injected into the system 10 through the tubular support 12 to thereby re-pressurize the annulus 118 defined within the expandable wellbore casing below the cup sub assembly 22. As a result, a pressure differential is once again created across the cup seal assembly 22 that causes the cup seal assembly to once again apply a tensile force in the direction 120 to the system 10. As a result, the system 10 is displaced upwardly in the direction 120 relative to the expandable wellbore casing 100 thereby pulling the adjustable casing expansion cone assembly 30 upwardly in the direction 120 through the expandable wellbore casing thereby radially expanding and plastically deforming the expandable wellbore casing and disengaging the stinger assembly 34 from the packer assembly 36. In an exemplary embodiment, during this operational mode, the packer assembly 36 prevents the flow of fluidic materials out of the expandable wellbore casing 100. As a result, the pressurization of the annulus 118 is rapid and efficient thereby enhancing the operational efficiency of the subsequent radial expansion and plastic deformation of the expandable wellbore casing 100.

[00049] In an exemplary embodiment, the tension actuator assembly 16 may also be operated during the re-injection of the fluidic material 116 to displace the adjustable casing expansion cone assembly 30 upwardly relative to the tubular support 12. As a result, additional expansion forces may be applied to the expandable wellbore casing 100.

[00050] As illustrated in Fig. 8, in an exemplary embodiment, the radial expansion and plastic deformation of the expandable wellbore casing using the adjustable casing expansion cone assembly 30 continues until the adjustable casing expansion cone assembly 30 reaches the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106. At which point, the system 10 may radially expand the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106 and the surrounding portion of the preexisting wellbore casing. Consequently, in an exemplary embodiment, during the radial expansion of the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106, the tension actuator assembly 16 is also operated to displace the adjustable casing expansion cone assembly 30 upwardly relative to the tubular support 12. As a result, additional expansion forces may be applied to the expandable wellbore casing 100 and the preexisting wellbore casing 106 during the radial expansion of the portion 124 of the expandable wellbore casing that overlaps with the preexisting wellbore casing.

[00051] As illustrated in Fig. 9, in an exemplary embodiment, the entire length of the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106 is not radially expanded and plastically deformed. Rather, only part of the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106 is radially expanded and plastically deformed. The remaining part of the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106 is then cut away by operating the casing cutter assembly 14.

[00052] As illustrated in Fig. 10, the remaining part of the portion 124 of the expandable wellbore casing 100 that overlaps with the preexisting wellbore casing 106 that is cut away by operating the casing cutter assembly 14 is then also carried out of the wellbore 102 using the casing cutter assembly.

[00053] Furthermore, in an exemplary embodiment, the inside diameter of the expandable wellbore casing 100 above the bell section 112 is equal to the inside diameter of the portion of the preexisting wellbore casing 106 that does not overlap with the expandable wellbore casing 100. As a result, a wellbore casing is constructed that includes overlapping wellbore casings that together define an internal passage having a constant cross-sectional area.

[00054] In an exemplary embodiment, one or more of the operational elements of the system 10 may be omitted, at least in part, and/or combined, at least in part, with one or more of the other operational elements of the system.

[00055] In several exemplary embodiments, the system 10 includes one or more of the methods and apparatus disclosed in one or more of the following: (1) U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (2) U.S. patent application serial no. 09/510,913, attorney docket no. 25791.7.02, filed on 2/23/2000, which claims priority from provisional application 60/121,702, filed on 2/25/99, (3) U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, which claims priority from provisional application 60/119,611, filed on 2/11/99, (4) U.S. patent no. 6,328,113, which was filed as

U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (5) U.S. patent application serial no. 10/169,434, attorney docket no. 25791.10.04, filed on 7/1/02, which claims priority from provisional application 60/183,546, filed on 2/18/00, (6) U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (7) U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (8) U.S. patent number 6,575,240, which was filed as patent application serial no. 09/511,941, attorney docket no. 25791.16.02, filed on 2/24/2000, which claims priority from provisional application 60/121,907, filed on 2/26/99, (9) U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (10) U.S. patent application serial no. 09/981,916, attorney docket no. 25791.18, filed on 10/18/01 as a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (11) U.S. patent number 6,604,763, which was filed as application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, which claims priority from provisional application 60/131,106, filed on 4/26/99, (12) U.S. patent application serial no. 10/030,593, attorney docket no. 25791.25.08, filed on 1/8/02, which claims priority from provisional application 60/146,203, filed on 7/29/99, (13) U.S. provisional patent application serial no. 60/143,039, attorney docket no. 25791.26, filed on 7/9/99, (14) U.S. patent application serial no. 10/111,982, attorney docket no. 25791.27.08, filed on 4/30/02, which claims priority from provisional patent application serial no. 60/162,671, attorney docket no. 25791.27, filed on 11/1/1999, (15) U.S. provisional patent application serial no. 60/154,047, attorney docket no. 25791.29, filed on 9/16/1999, (16) U.S. provisional patent application serial no. 60/438,828, attorney docket no. 25791.31, filed on 1/9/03, (17) U.S. patent number 6,564,875, which was filed as application serial no. 09/679,907, attorney docket no. 25791.34.02, on 10/5/00, which claims priority from provisional patent application serial no. 60/159,082, attorney docket no. 25791.34, filed on 10/12/1999, (18) U.S. patent application serial no. 10/089,419, filed on 3/27/02, attorney docket no. 25791.36.03, which claims priority from provisional patent application serial no. 60/159,039, attorney docket no. 25791.36, filed on 10/12/1999, (19) U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (20) U.S. patent application serial no. 10/303,992, filed on 11/22/02, attorney docket no. 25791.38.07, which claims priority from provisional patent application serial no. 60/212,359, attorney docket no. 25791.38, filed on 6/19/2000, (21) U.S. provisional patent application serial no. 60/165,228, attorney docket no. 25791.39, filed on 11/12/1999, (22) U.S. provisional patent application serial no. 60/455,051, attorney docket no. 25791.40, filed on 3/14/03, (23) PCT application US02/2477, filed on 6/26/02, attorney docket no. 25791.44.02, which claims priority from U.S. provisional patent application serial no. 60/303,711, attorney docket no. 25791.44,

filed on 7/6/01, (24) U.S. patent application serial no. 10/311,412, filed on 12/12/02, attorney docket no. 25791.45.07, which claims priority from provisional patent application serial no. 60/221,443, attorney docket no. 25791.45, filed on 7/28/2000, (25) U.S. patent application serial no. 10/, filed on 12/18/02, attorney docket no. 25791.46.07, which claims priority from provisional patent application serial no. 60/221,645, attorney docket no. 25791.46, filed on 7/28/2000, (26) U.S. patent application serial no. 10/322,947, filed on 1/22/03, attorney docket no. 25791.47.03, which claims priority from provisional patent application serial no. 60/233,638, attorney docket no. 25791.47, filed on 9/18/2000, (27) U.S. patent application serial no. 10/406,648, filed on 3/31/03, attorney docket no. 25791.48.06, which claims priority from provisional patent application serial no. 60/237,334, attorney docket no. 25791.48, filed on 10/2/2000, (28) PCT application US02/04353, filed on 2/14/02, attorney docket no. 25791.50.02, which claims priority from U.S. provisional patent application serial no. 60/270,007, attorney docket no. 25791.50, filed on 2/20/2001, (29) U.S. patent application serial no. 10/465,835, filed on 6/13/03, attorney docket no. 25791.51.06, which claims priority from provisional patent application serial no. 60/262,434, attorney docket no. 25791.51, filed on 1/17/2001, (30) U.S. patent application serial no. 10/465,831, filed on 6/13/03, attorney docket no. 25791.52.06, which claims priority from U.S. provisional patent application serial no. 60/259,486, attorney docket no. 25791.52, filed on 1/3/2001, (31) U.S. provisional patent application serial no. 60/452,303, filed on 3/5/03, attorney docket no. 25791.53, (32) U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (33) U.S. patent number 6,561,227, which was filed as patent application serial number 09/852,026, filed on 5/9/01, attorney docket no. 25791.56, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (34) U.S. patent application serial number 09/852,027, filed on 5/9/01, attorney docket no. 25791.57, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (35) PCT Application US02/25608, attorney docket no. 25791.58.02, filed on 8/13/02, which claims priority from provisional application 60/318,021, filed on 9/7/01, attorney docket no. 25791.58, (36) PCT Application US02/24399, attorney docket no. 25791.59.02, filed on 8/1/02, which claims priority from U.S. provisional patent application serial no. 60/313,453, attorney docket no. 25791.59, filed on 8/20/2001, (37) PCT Application US02/29856, attorney docket no. 25791.60.02, filed on 9/19/02, which claims priority from U.S. provisional patent application serial no. 60/326,886, attorney docket no. 25791.60, filed on 10/3/2001, (38) PCT Application US02/20256, attorney docket no. 25791.61.02, filed on 6/26/02, which claims priority from U.S. provisional patent application serial no. 60/303,740, attorney docket no. 25791.61, filed on 7/6/2001, (39) U.S. patent application serial no. 09/962,469, filed on 9/25/01, attorney docket no. 25791.62, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000,

which claims priority from provisional application 60/124,042, filed on 3/11/99, (40) U.S. patent application serial no. 09/962,470, filed on 9/25/01, attorney docket no. 25791.63, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (41) U.S. patent application serial no. 09/962,471, filed on 9/25/01, attorney docket no. 25791.64, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (42) U.S. patent application serial no. 09/962,467, filed on 9/25/01, attorney docket no. 25791.65, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (43) U.S. patent application serial no. 09/962,468, filed on 9/25/01, attorney docket no. 25791.66, which is a divisional of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (44) PCT application US 02/25727, filed on 8/14/02, attorney docket no. 25791.67.03, which claims priority from U.S. provisional patent application serial no. 60/317,985, attorney docket no. 25791.67, filed on 9/6/2001, and U.S. provisional patent application serial no. 60/318,386, attorney docket no. 25791.67.02, filed on 9/10/2001, (45) PCT application US 02/39425, filed on 12/10/02, attorney docket no. 25791.68.02, which claims priority from U.S. provisional patent application serial no. 60/343,674, attorney docket no. 25791.68, filed on 12/27/2001, (46) U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (47) U.S. utility patent application serial no. 10/516,467, attorney docket no. 25791.70, filed on 12/10/01, which is a continuation application of U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (48) PCT application US 03/00609, filed on 1/9/03, attorney docket no. 25791.71.02, which claims priority from U.S. provisional patent application serial no. 60/357,372, attorney docket no. 25791.71, filed on 2/15/02, (49) U.S. patent application serial no. 10/074,703, attorney docket no. 25791.74, filed on 2/12/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (50) U.S. patent application serial no. 10/074,244, attorney docket no. 25791.75, filed on 2/12/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (51) U.S. patent application serial no. 10/076,660, attorney docket no. 25791.76, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on

2/26/99, (52) U.S. patent application serial no. 10/076,661, attorney docket no. 25791.77, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (53) U.S. patent application serial no. 10/076,659, attorney docket no. 25791.78, filed on 2/15/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (54) U.S. patent application serial no. 10/078,928, attorney docket no. 25791.79, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (55) U.S. patent application serial no. 10/078,922, attorney docket no. 25791.80, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (56) U.S. patent application serial no. 10/078,921, attorney docket no. 25791.81, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (57) U.S. patent application serial no. 10/261,928, attorney docket no. 25791.82, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (58) U.S. patent application serial no. 10/079,276, attorney docket no. 25791.83, filed on 2/20/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (59) U.S. patent application serial no. 10/262,009, attorney docket no. 25791.84, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (60) U.S. patent application serial no. 10/092,481, attorney docket no. 25791.85, filed on 3/7/02, which is a divisional of U.S. patent number 6,568,471, which was filed as patent application serial no. 09/512,895, attorney docket no. 25791.12.02, filed on 2/24/2000, which claims priority from provisional application 60/121,841, filed on 2/26/99, (61) U.S. patent application serial no. 10/261,926, attorney docket no. 25791.86, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (62) PCT application US 02/36157, filed on 11/12/02, attorney docket no. 25791.87.02, which claims priority from U.S. provisional patent application serial no. 60/338,996, attorney docket no. 25791.87, filed on 11/12/01, (63) PCT application US 02/36267, filed on 11/12/02, attorney docket no. 25791.88.02, which claims priority from U.S. provisional patent application serial no. 60/339,013, attorney docket no. 25791.88, filed on 11/12/01, (64) PCT application US 03/11765, filed on 4/16/03, attorney docket

no. 25791.89.02, which claims priority from U.S. provisional patent application serial no. 60/383,917, attorney docket no. 25791.89, filed on 5/29/02, (65) PCT application US 03/15020, filed on 5/12/03, attorney docket no. 25791.90.02, which claims priority from U.S. provisional patent application serial no. 60/391,703, attorney docket no. 25791.90, filed on 6/26/02, (66) PCT application US 02/39418, filed on 12/10/02, attorney docket no. 25791.92.02, which claims priority from U.S. provisional patent application serial no. 60/346,309, attorney docket no. 25791.92, filed on 1/7/02, (67) PCT application US 03/06544, filed on 3/4/03, attorney docket no. 25791.93.02, which claims priority from U.S. provisional patent application serial no. 60/372,048, attorney docket no. 25791.93, filed on 4/12/02, (68) U.S. patent application serial no. 10/331,718, attorney docket no. 25791.94, filed on 12/30/02, which is a divisional U.S. patent application serial no. 09/679,906, filed on 10/5/00, attorney docket no. 25791.37.02, which claims priority from provisional patent application serial no. 60/159,033, attorney docket no. 25791.37, filed on 10/12/1999, (69) PCT application US 03/04837, filed on 2/29/03, attorney docket no. 25791.95.02, which claims priority from U.S. provisional patent application serial no. 60/363,829, attorney docket no. 25791.95, filed on 3/13/02, (70) U.S. patent application serial no. 10/261,927, attorney docket no. 25791.97, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (71) U.S. patent application serial no. 10/262,008, attorney docket no. 25791.98, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (72) U.S. patent application serial no. 10/261,925, attorney docket no. 25791.99, filed on 10/1/02, which is a divisional of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (73) U.S. patent application serial no. 10/199,524, attorney docket no. 25791.100, filed on 7/19/02, which is a continuation of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (74) PCT application US 03/10144, filed on 3/28/03, attorney docket no. 25791.101.02, which claims priority from U.S. provisional patent application serial no. 60/372,632, attorney docket no. 25791.101, filed on 4/15/02, (75) U.S. provisional patent application serial no. 60/412,542, attorney docket no. 25791.102, filed on 9/20/02, (76) PCT application US 03/14153, filed on 5/6/03, attorney docket no. 25791.104.02, which claims priority from U.S. provisional patent application serial no. 60/380,147, attorney docket no. 25791.104, filed on 5/6/02, (77) PCT application US 03/19993, filed on 6/24/03, attorney docket no. 25791.106.02, which claims priority from U.S. provisional patent application serial no. 60/397,284, attorney docket no. 25791.106, filed on 7/19/02, (78) PCT application US 03/13787, filed on 5/5/03, attorney docket no. 25791.107.02, which claims priority from U.S. provisional patent application serial no. 60/387,486, attorney docket no. 25791.107, filed on 6/10/02, (79) PCT application US 03/18530, filed on 6/11/03, attorney docket no. 25791.108.02, which claims priority from U.S. provisional patent application serial no. 60/387,961, attorney docket no. 25791.108, filed on 6/12/02, (80) PCT

application US 03/20694, filed on 7/1/03, attorney docket no. 25791.110.02, which claims priority from U.S. provisional patent application serial no. 60/398,061, attorney docket no. 25791.110, filed on 7/24/02, (81) PCT application US 03/20870, filed on 7/2/03, attorney docket no. 25791.111.02, which claims priority from U.S. provisional patent application serial no. 60/399,240, attorney docket no. 25791.111, filed on 7/29/02, (82) U.S. provisional patent application serial no. 60/412,487, attorney docket no. 25791.112, filed on 9/20/02, (83) U.S. provisional patent application serial no. 60/412,488, attorney docket no. 25791.114, filed on 9/20/02, (84) U.S. patent application serial no. 10/280,356, attorney docket no. 25791.115, filed on 10/25/02, which is a continuation of U.S. patent number 6,470,966, which was filed as patent application serial number 09/850,093, filed on 5/7/01, attorney docket no. 25791.55, as a divisional application of U.S. Patent Number 6,497,289, which was filed as U.S. Patent Application serial no. 09/454,139, attorney docket no. 25791.03.02, filed on 12/3/1999, which claims priority from provisional application 60/111,293, filed on 12/7/98, (85) U.S. provisional patent application serial no. 60/412,177, attorney docket no. 25791.117, filed on 9/20/02, (86) U.S. provisional patent application serial no. 60/412,653, attorney docket no. 25791.118, filed on 9/20/02, (87) U.S. provisional patent application serial no. 60/405,610, attorney docket no. 25791.119, filed on 8/23/02, (88) U.S. provisional patent application serial no. 60/405,394, attorney docket no. 25791.120, filed on 8/23/02, (89) U.S. provisional patent application serial no. 60/412,544, attorney docket no. 25791.121, filed on 9/20/02, (90) PCT application US 03/24779, filed on 8/8/03, attorney docket no. 25791.125.02, which claims priority from U.S. provisional patent application serial no. 60/407,442, attorney docket no. 25791.125, filed on 8/30/02, (91) U.S. provisional patent application serial no. 60/423,363, attorney docket no. 25791.126, filed on 12/10/02, (92) U.S. provisional patent application serial no. 60/412,196, attorney docket no. 25791.127, filed on 9/20/02, (93) U.S. provisional patent application serial no. 60/412,187, attorney docket no. 25791.128, filed on 9/20/02, (94) U.S. provisional patent application serial no. 60/412,371, attorney docket no. 25791.129, filed on 9/20/02, (95) U.S. patent application serial no. 10/382,325, attorney docket no. 25791.145, filed on 3/5/03, which is a continuation of U.S. patent number 6,557,640, which was filed as patent application serial no. 09/588,946, attorney docket no. 25791.17.02, filed on 6/7/2000, which claims priority from provisional application 60/137,998, filed on 6/7/99, (96) U.S. patent application serial no. 10/624,842, attorney docket no. 25791.151, filed on 7/22/03, which is a divisional of U.S. patent application serial no. 09/502,350, attorney docket no. 25791.8.02, filed on 2/10/2000, which claims priority from provisional application 60/119,611, filed on 2/11/99, (97) U.S. provisional patent application serial no. 60/431,184, attorney docket no. 25791.157, filed on 12/5/02, (98) U.S. provisional patent application serial no. 60/448,526, attorney docket no. 25791.185, filed on 2/18/03, (99) U.S. provisional patent application serial no. 60/461,539, attorney docket no. 25791.186, filed on 4/9/03, (100) U.S. provisional patent application serial no. 60/462,750, attorney docket no. 25791.193, filed on 4/14/03, (101) U.S. provisional patent application serial no. 60/436,106, attorney docket no. 25791.200, filed on 12/23/02, (102) U.S. provisional patent application serial no. 60/442,942, attorney docket no. 25791.213, filed on 1/27/03, (103) U.S. provisional patent application serial no. 60/442,938, attorney docket no. 25791.225, filed on 1/27/03, (104) U.S. provisional patent application serial no. 60/418,687, attorney docket no. 25791.228, filed on 4/18/03, (105) U.S. provisional patent application

serial no. 60/454,896, attorney docket no. 25791.236, filed on 3/14/03, (106) U.S. provisional patent application serial no. 60/450,504, attorney docket no. 25791.238, filed on 2/26/03, (107) U.S. provisional patent application serial no. 60/451,152, attorney docket no. 25791.239, filed on 3/9/03, (108) U.S. provisional patent application serial no. 60/455,124, attorney docket no. 25791.241, filed on 3/17/03, (109) U.S. provisional patent application serial no. 60/453,678, attorney docket no. 25791.253, filed on 3/11/03, (110) U.S. patent application serial no. 10/421,682, attorney docket no. 25791.256, filed on 4/23/03, which is a continuation of U.S. patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (111) U.S. provisional patent application serial no. 60/457,965, attorney docket no. 25791.260, filed on 3/27/03, (112) U.S. provisional patent application serial no. 60/455,718, attorney docket no. 25791.262, filed on 3/18/03, (113) U.S. patent number 6,550,821, which was filed as patent application serial no. 09/811,734, filed on 3/19/01, (114) U.S. patent application serial no. 10/436,467, attorney docket no. 25791.268, filed on 5/12/03, which is a continuation of U.S. patent number 6,604,763, which was filed as application serial no. 09/559,122, attorney docket no. 25791.23.02, filed on 4/26/2000, which claims priority from provisional application 60/131,106, filed on 4/26/99, (115) U.S. provisional patent application serial no. 60/459,776, attorney docket no. 25791.270, filed on 4/2/03, (116) U.S. provisional patent application serial no. 60/461,094, attorney docket no. 25791.272, filed on 4/8/03, (117) U.S. provisional patent application serial no. 60/461,038, attorney docket no. 25791.273, filed on 4/7/03, (118) U.S. provisional patent application serial no. 60/463,586, attorney docket no. 25791.277, filed on 4/17/03, (119) U.S. provisional patent application serial no. 60/472,240, attorney docket no. 25791.286, filed on 5/20/03, (120) U.S. patent application serial no. 10/619,285, attorney docket no. 25791.292, filed on 7/14/03, which is a continuation-in-part of U.S. utility patent application serial no. 09/969,922, attorney docket no. 25791.69, filed on 10/3/2001, which is a continuation-in-part application of U.S. patent no. 6,328,113, which was filed as U.S. Patent Application serial number 09/440,338, attorney docket number 25791.9.02, filed on 11/15/99, which claims priority from provisional application 60/108,558, filed on 11/16/98, (121) U.S. utility patent application serial no. 10/418,688, attorney docket no. 25791.257, which was filed on 4/18/03, as a division of U.S. utility patent application serial no. 09/523,468, attorney docket no. 25791.11.02, filed on 3/10/2000, which claims priority from provisional application 60/124,042, filed on 3/11/99, (122) PCT patent application serial no. PCT/US04/06246, attorney docket no. 25791.238.02, filed on 2/26/2004, (123) PCT patent application serial number PCT/US04/08170, attorney docket number 25791.40.02, filed on 3/15/04, (124) PCT patent application serial number PCT/US04/08171, attorney docket number 25791.236.02, filed on 3/15/04, (125) PCT patent application serial number PCT/US04/08073, attorney docket number 25791.262.02, filed on 3/18/04, (126) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, (127) PCT patent application serial number PCT/US04/009434, attorney docket number 25791.260.02, filed on 3/26/2004, (128) PCT patent application serial number PCT/US04/010317, attorney docket number 25791.270.02, filed on 4/2/2004, (129) PCT patent application serial number PCT/US04/010712, attorney docket number 25791.272.02, filed on 4/7/2004, and (130) PCT patent application serial number PCT/US04/010762,

attorney docket number 25791.273.02, filed on 4/6/2004, and/or PCT application serial number PCT/US04/011973, attorney docket number 25791.277.02, filed on 4/15/2004, the disclosures of which are incorporated herein by reference.

[00056] In an exemplary embodiment, the casing cutter assembly 14 is provided and operates substantially, at least in part, as disclosed in one or more of the following: (1) PCT patent application serial number PCT/US03/29858, attorney docket number 25791.112.02, filed on 9/22/2003, and/or (2) PCT patent application serial number PCT/US04/07711, attorney docket number 25791.253.02, filed on 3/11/2004, and/or (3) PCT patent application serial number PCT/US04/009434, attorney docket number 25791.260.02, filed on 3/26/2004, and/or (4) PCT patent application serial number PCT/US04/10317, attorney docket number 25791.270.02, filed on 4/2/2004, (5) PCT patent application serial number PCT/US04/010712, attorney docket number 25791.272.02, filed on 4/7/2004, and/or (6) PCT patent application serial number PCT/US04/010762, attorney docket number 25791.273.02, filed on 4/6/2004, and/or PCT application serial number PCT/US04/011973, attorney docket number 25791.277.02, filed on 4/15/2004, the disclosures of which are incorporated herein by reference.

[00057] In an exemplary embodiment, as illustrated in Figs. 13A1 to 13A8 and 13B1 to 13B7, the tension actuator assembly 18 includes an upper tubular support member 18002 that defines a longitudinal passage 18002a, and external internally threaded radial openings, 18002b and 18002c, and an external annular recess 18002d and includes an internally threaded connection 18002e at one end and an external flange 18002f, an external annular recess 18002g having an externally threaded connection, and an internal annular recess 18002h having an internally threaded connection at another end. An end of a tubular actuator barrel 18004 that defines radial passages, 18004a and 18004b, at one end and radial passages, 18004c and 18004d, includes an internally threaded connection 18004e at one end that mates with, receives, and is threadably coupled to the external annular recess 18002g of the upper tubular support member 18002 and abuts an end face of the external flange 18002f of the upper tubular support member and an internally threaded connection 18004f at another end.

[00058] Torsional locking pins, 18006a and 18006b, are coupled to and mounted within the external radial mounting holes, 18002b and 18002c, respectively, of the upper tubular support member and received within the radial passages, 18004a and 18004b, of the end of the tubular actuator barrel 18004. The other end of the tubular actuator barrel 18004 receives and is threadably coupled to an end of a tubular barrel connector 18008 that defines an internal annular recess 18008a, external radial mounting holes, 18008b and 18008c, radial passages, 18008d and 18008e, and external radial mounting holes, 18008f and 18008g and includes circumferentially spaced apart teeth 18008h at one end. A sealing cartridge 18010 is received within and coupled to the internal annular recess 18008a of the tubular barrel connector 18008 for fluidically sealing the interface between the tubular barrel connector and the sealing cartridge. Torsional locking pins, 18012a and 18012b, are coupled to and mounted within the external radial mounting holes, 18008b and 18008c, respectively, of the tubular barrel connector 18008 and received within the radial passages, 18004c and 18004d, of the tubular actuator barrel 18004.

[00059] A tubular member 18014 that defines a longitudinal passage 18014a having one or more internal splines 18014b at one end and circumferentially spaced apart teeth 18014c at another end for engaging the circumferentially spaced apart teeth 18008h of the tubular barrel connector 18008 mates with and is received within the actuator barrel 18004 and the one end of the tubular member abuts an end face of the other end of the upper tubular support member 18002 and at another end abuts an end face of the tubular barrel connector 18008. A tubular guide member 18016 that defines a longitudinal passage 18016a having a tapered opening 18016aa, and radial passages, 18016b and 18016c, includes an external flange 18016d having an externally threaded connection at one end that is received within and coupled to the internal annular recess 18002h of the upper tubular support member 18002.

[00060] The other end of the tubular barrel connector 18008 is threadably coupled to and is received within an end of a tubular actuator barrel 18018 that defines a longitudinal passage 18018a, radial passages, 18018b and 18018c, and radial passages, 18018d and 18018e. Torsional locking pins, 18020a and 18020b, are coupled to and mounted within the external radial mounting holes, 18008f and 18008g, respectively, of the tubular barrel connector 18008 and received within the radial passages, 18018b and 18018c, of the tubular actuator barrel 18018. The other end of the tubular actuator barrel 18018 receives and is threadably coupled to an end of a tubular barrel connector 18022 that defines an internal annular recess 18022a, external radial mounting holes, 18022b and 18022c, radial passages, 18022d and 18022e, and external radial mounting holes, 18022f and 18022g. A sealing cartridge 18024 is received within and coupled to the internal annular recess 18022a of the tubular barrel connector 18022 for fluidically sealing the interface between the tubular barrel connector and the sealing cartridge. Torsional locking pins, 18024a and 18024b, are coupled to and mounted within the external radial mounting holes, 18022b and 18022c, respectively, of the barrel connector 18022 and received within the radial passages, 18018d and 18018e, of the tubular actuator barrel 18018.

[00061] The other end of the tubular barrel connector 18022 is threadably coupled to and is received within an end of a tubular actuator barrel 18026 that defines a longitudinal passage 18026a, radial passages, 18026b and 18026c, and radial passages, 18026d and 18026e. Torsional locking pins, 18028a and 18028b, are coupled to and mounted within the external radial mounting holes, 18022f and 18022g, respectively, of the tubular barrel connector 18022 and received within the radial passages, 18026b and 18026c, of the tubular actuator barrel 18026. The other end of the tubular actuator barrel 18026 receives and is threadably coupled to an end of a tubular barrel connector 18030 that defines an internal annular recess 18030a, external radial mounting holes, 18030b and 18030c, radial passages, 18030d and 18030e, and external radial mounting holes, 18030f and 18030g. A sealing cartridge 18032 is received within and coupled to the internal annular recess 18030a of the tubular barrel connector 18030 for fluidically sealing the interface between the tubular barrel connector and the sealing cartridge. Torsional locking pins, 18034a and 18034b, are coupled to and mounted within the external radial mounting holes, 18030b and 18030c, respectively, of the tubular barrel connector 18030 and received within the radial passages, 18026d and 18026e, of the tubular actuator barrel 18026.

[00062] The other end of the tubular barrel connector 18030 is threadably coupled to and is received within an end of a tubular actuator barrel 18036 that defines a longitudinal passage 18036a, radial passages, 18036b and 18036c, and radial passages, 18036d and 18036e. Torsional locking pins, 18038a and 18038b, are coupled to and mounted within the external radial mounting holes, 18030f and 18030g, respectively, of the tubular barrel connector 18030 and received within the radial passages, 18036b and 18036c, of the tubular actuator barrel 18036. The other end of the tubular actuator barrel 18036 receives and is threadably coupled to an end of a tubular barrel connector 18040 that defines an internal annular recess 18040a, external radial mounting holes, 18040b and 18040c, radial passages, 18040d and 18040e, and external radial mounting holes, 18040f and 18040g. A sealing cartridge 18042 is received within and coupled to the internal annular recess 18040a of the tubular barrel connector 18040 for fluidically sealing the interface between the tubular barrel connector and the sealing cartridge. Torsional locking pins, 18044a and 18044b, are coupled to and mounted within the external radial mounting holes, 18040b and 18040c, respectively, of the tubular barrel connector 18040 and received within the radial passages, 18036d and 18036e, of the tubular actuator barrel 18036.

[00063] The other end of the tubular barrel connector 18040 is threadably coupled to and is received within an end of a tubular actuator barrel 18046 that defines a longitudinal passage 18046a, radial passages, 18046b and 18046c, and radial passages, 18046d and 18046e. Torsional locking pins, 18048a and 18048b, are coupled to and mounted within the external radial mounting holes, 18040f and 18040g, respectively, of the tubular barrel connector 18040 and received within the radial passages, 18046b and 18046c, of the tubular actuator barrel 18046. The other end of the tubular actuator barrel 18046 receives and is threadably coupled to an end of a tubular barrel connector 18050 that defines an internal annular recess 18050a, external radial mounting holes, 18050b and 18050c, radial passages, 18050d and 18050e, and external radial mounting holes, 18050f and 18050g. A sealing cartridge 18052 is received within and coupled to the internal annular recess 18050a of the tubular barrel connector 18050 for fluidically sealing the interface between the tubular barrel connector and the sealing cartridge. Torsional locking pins, 18054a and 18054b, are coupled to and mounted within the external radial mounting holes, 18050b and 18050c, respectively, of the tubular barrel connector 18050 and received within the radial passages, 18046d and 18046e, of the tubular actuator barrel 18046.

[00064] The other end of the tubular barrel connector 18050 is threadably coupled to and is received within an end of a tubular actuator barrel 18056 that defines a longitudinal passage 18056a, radial passages, 18056b and 18056c, and radial passages, 18056d and 18056e. Torsional locking pins, 18058a and 18058b, are coupled to and mounted within the external radial mounting holes, 18050f and 18050g, respectively, of the tubular barrel connector 18050 and received within the radial passages, 18056b and 18056c, of the tubular actuator barrel 18056. The other end of the tubular actuator barrel 18056 receives and is threadably coupled to an end of a tubular lower stop 18060 that defines an internal annular recess 18060a, external radial mounting holes, 18060b and 18060c, and an internal annular recess 18060d that includes one or more circumferentially spaced apart locking teeth 18060e at one end and one or more circumferentially spaced apart locking teeth 18060f at the

other end. A sealing cartridge 18062 is received within and coupled to the internal annular recess 18060a of the tubular lower stop 18060 for fluidically sealing the interface between the tubular lower stop and the sealing cartridge. Torsional locking pins, 18064a and 18064b, are coupled to and mounted within the external radial mounting holes, 18060b and 18060c, respectively, of the tubular lower stop 18060 and received within the radial passages, 18056d and 18056e, of the tubular actuator barrel 18056.

[00065] A connector tube 18066 that defines a longitudinal passage 18066a and radial mounting holes, 18066b and 18066c, and includes external splines 18066d at one end for engaging the internal splines 18014b of the tubular member 18014 and radial mounting holes, 18066e and 18066f, at another end is received within and sealingly and movably engages the interior surface of the sealing cartridge 18010 mounted within the annular recess 18008a of the tubular barrel connector 18008. In this manner, during longitudinal displacement of the connector tube 18066 relative to the tubular barrel connector 18008, a fluidic seal is maintained between the exterior surface of the connector tube and the interior surface of the tubular barrel connector. An end of the connector tube 18066 also receives and mates with the other end of the tubular guide member 18016. Mounting screws, 18068a and 18068b, are coupled to and received within the radial mounting holes, 18066b and 18066c, respectively of the connector tube 18066.

[00066] The other end of the connector tube 18066 is received within and threadably coupled to an end of a tubular piston 18070 that defines a longitudinal passage 18070a, radial mounting holes, 18070b and 18070c, radial passages, 18070d and 18070e, and radial mounting holes, 18070f and 18070g, that includes a flange 18070h at one end. A sealing cartridge 18072 is mounted onto and sealingly coupled to the exterior of the tubular piston 18070 proximate the flange 18070h. The sealing cartridge 18072 also mates with and sealingly engages the interior surface of the tubular actuator barrel 18018. In this manner, during longitudinal displacement of the tubular piston 18070 relative to the actuator barrel 18018, a fluidic seal is maintained between the exterior surface of the piston and the interior surface of the actuator barrel. Mounting screws, 18074a and 18074b, are coupled to and mounted within the external radial mounting holes, 18070b and 18070c, respectively, of the tubular piston 18070 and received within the radial passages, 18066e and 18066f, of the connector tube 18066.

[00067] The other end of the tubular piston 18070 receives and is threadably coupled to an end of a connector tube 18076 that defines a longitudinal passage 18076a, radial mounting holes, 18076b and 18076c, at one end and radial mounting holes, 18076d and 18076e, at another end. The connector tube 18076 is received within and sealingly and movably engages the interior surface of the sealing cartridge 18024 mounted within the annular recess 18022a of the tubular barrel connector 18022. In this manner, during longitudinal displacement of the connector tube 18076 relative to the tubular barrel connector 18022, a fluidic seal is maintained between the exterior surface of the connector tube and the interior surface of the barrel connector. Mounting screws, 18078a and 18078b, are coupled to and mounted within the external radial mounting holes, 18070f and 18070g, respectively, of the tubular piston 18070 and received within the radial passages, 18076b and 18076c, of the connector tube 18076.

[00068] The other end of the connector tube 18076 is received within and threadably coupled to an end of a tubular piston 18080 that defines a longitudinal passage 18080a, radial mounting holes, 18080b and 18080c, radial passages, 18080d and 18080e, and radial mounting holes, 18080f and 18080g, that includes a flange 18080h at one end. A sealing cartridge 18082 is mounted onto and sealingly coupled to the exterior of the tubular piston 18080 proximate the flange 18080h. The sealing cartridge 18082 also mates with and sealingly engages the interior surface of the tubular actuator barrel 18026. In this manner, during longitudinal displacement of the tubular piston 18080 relative to the tubular actuator barrel 18026, a fluidic seal is maintained between the exterior surface of the piston and the interior surface of the actuator barrel. Mounting screws, 18084a and 18084b, are coupled to and mounted within the external radial mounting holes, 18080b and 18080c, respectively, of the tubular piston 18080 and received within the radial passages, 18076e and 18076f, of the connector tube 18076.

[00069] The other end of the tubular piston 18080 receives and is threadably coupled to an end of a connector tube 18086 that defines a longitudinal passage 18086a, radial mounting holes, 18086b and 18086c, at one end and radial mounting holes, 18086d and 18086e, at another end. The connector tube 18086 is received within and sealingly and movably engages the interior surface of the sealing cartridge 18032 mounted within the annular recess 18030a of the tubular barrel connector 18030. In this manner, during longitudinal displacement of the connector tube 18086 relative to the tubular barrel connector 18030, a fluidic seal is maintained between the exterior surface of the connector tube and the interior surface of the barrel connector. Mounting screws, 18088a and 18088b, are coupled to and mounted within the external radial mounting holes, 18080f and 18080g, respectively, of the tubular piston 18080 and received within the radial passages, 18086b and 18086c, of the connector tube 18086.

[00070] The other end of the connector tube 18086 is received within and threadably coupled to an end of a tubular piston 18090 that defines a longitudinal passage 18090a, radial mounting holes, 18090b and 18090c, radial passages, 18090d and 18090e, and radial mounting holes, 18090f and 18090g, that includes a flange 18090h at one end. A sealing cartridge 18092 is mounted onto and sealingly coupled to the exterior of the tubular piston 18090 proximate the flange 18090h. The sealing cartridge 18092 also mates with and sealingly engages the interior surface of the tubular actuator barrel 18036. In this manner, during longitudinal displacement of the tubular piston 18090 relative to the tubular actuator barrel 18036, a fluidic seal is maintained between the exterior surface of the piston and the interior surface of the actuator barrel. Mounting screws, 18094a and 18094b, are coupled to and mounted within the external radial mounting holes, 18090b and 18090c, respectively, of the tubular piston 18090 and received within the radial passages, 18086e and 18086f, of the connector tube 18086.

[00071] The other end of the tubular piston 18090 receives and is threadably coupled to an end of a connector tube 18096 that defines a longitudinal passage 18096a, radial mounting holes, 18096b and 18096c, at one end and radial mounting holes, 18096d and 18096e, at another end. The connector tube 18096 is received within and sealingly and movably engages the interior surface of the sealing cartridge 18042 mounted within the annular recess 18040a of the tubular barrel connector

18040. In this manner, during longitudinal displacement of the connector tube 18096 relative to the tubular barrel connector 18040, a fluidic seal is maintained between the exterior surface of the connector tube and the interior surface of the barrel connector. Mounting screws, 18098a and 18098b, are coupled to and mounted within the external radial mounting holes, 18090f and 18090g, respectively, of the tubular piston 18090 and received within the radial passages, 18096b and 18096c, of the connector tube 18096.

[00072] The other end of the connector tube 18096 is received within and threadably coupled to an end of a tubular piston 18100 that defines a longitudinal passage 18100a, radial mounting holes, 18100b and 18100c, radial passages, 18100d and 18100e, and radial mounting holes, 18100f and 18100g, that includes a flange 18100h at one end. A sealing cartridge 18102 is mounted onto and sealingly coupled to the exterior of the tubular piston 18100 proximate the flange 18100h. The sealing cartridge 18102 also mates with and sealingly engages the interior surface of the tubular actuator barrel 18046. In this manner, during longitudinal displacement of the tubular piston 18100 relative to the tubular actuator barrel 18046, a fluidic seal is maintained between the exterior surface of the piston and the interior surface of the actuator barrel. Mounting screws, 18104a and 18104b, are coupled to and mounted within the external radial mounting holes, 18100b and 18100c, respectively, of the tubular piston 18100 and received within the radial passages, 18096e and 18096f, of the connector tube 18096.

[00073] The other end of the tubular piston 18100 receives and is threadably coupled to an end of a connector tube 18106 that defines a longitudinal passage 18106a, radial mounting holes, 18106b and 18106c, at one end and radial mounting holes, 18106d and 18106e, at another end. The connector tube 18106 is received within and sealingly and movably engages the interior surface of the sealing cartridge 18052 mounted within the annular recess 18050a of the tubular barrel connector 18050. In this manner, during longitudinal displacement of the connector tube 18106 relative to the tubular barrel connector 18050, a fluidic seal is maintained between the exterior surface of the connector tube and the interior surface of the barrel connector. Mounting screws, 18108a and 18108b, are coupled to and mounted within the external radial mounting holes, 18100f and 18100g, respectively, of the tubular piston 18100 and received within the radial passages, 18106b and 18106c, of the connector tube 18106.

[00074] The other end of the connector tube 18106 is received within and threadably coupled to an end of a tubular piston 18110 that defines a longitudinal passage 18110a, radial mounting holes, 18110b and 18110c, radial passages, 18110d and 18110e, radial mounting holes, 18110f and 18110g, that includes a flange 18110h at one end and circumferentially spaced teeth 18110i at another end for engaging the one or more circumferentially spaced apart locking teeth 18060e of the tubular lower stop 18060. A sealing cartridge 18112 is mounted onto and sealingly coupled to the exterior of the tubular piston 18110 proximate the flange 18110h. The sealing cartridge 18112 also mates with and sealingly engages the interior surface of the actuator barrel 18056. In this manner, during longitudinal displacement of the tubular piston 18110 relative to the actuator barrel 18056, a fluidic seal is maintained between the exterior surface of the piston and the interior surface of the actuator barrel. Mounting screws, 18114a and 18114b, are coupled to and mounted within the

external radial mounting holes, 18110b and 18110c, respectively, of the tubular piston 18110 and received within the radial passages, 18106d and 18106e, of the connector tube 18106.

[00075] The other end of the tubular piston 18110 receives and is threadably coupled to an end of a connector tube 18116 that defines a longitudinal passage 18116a, radial mounting holes, 18116b and 18116c, at one end and radial mounting holes, 18116d and 18116e, at another end that includes an external flange 18116f that includes circumferentially spaced apart teeth 18116g that extend from an end face of the external flange for engaging the teeth 18060f of the tubular lower stop 18060, and an externally threaded connection 18116h at another end. The connector tube 18116 is received within and sealingly and movably engages the interior surface of the sealing cartridge 18062 mounted within the annular recess 18060a of the lower tubular stop 18060. In this manner, during longitudinal displacement of the connector tube 18116 relative to the lower tubular stop 18060, a fluidic seal is maintained between the exterior surface of the connector tube and the interior surface of the lower tubular stop. Mounting screws, 18118a and 18118b, are coupled to and mounted within the external radial mounting holes, 18110f and 18110g, respectively, of the tubular piston 18110 and received within the radial passages, 18116b and 18116c, of the connector tube 18116.

[00076] In an exemplary embodiment, as illustrated in Figs. 13A1 to 13A8, the internally threaded connection 18002e of the upper tubular support member 18002 receives and is coupled to the externally threaded connection 1234g of the lower mandrel 1234 of the ball grabber assembly 16 and the externally threaded connection 18116h of the connector tube 18116 is received within and is coupled to an internally threaded connection 20a of an end of the safety sub assembly 20.

[00077] In an exemplary embodiment, as illustrated in Figs. 13A1 to 13A8, during operation of the tension actuator assembly 18, the tension actuator assembly is positioned within the expandable wellbore casing 100 and fluidic material 18200 is injected into the tension actuator assembly through the passages 18002a, 18016a, 18066a, 18070a, 18076a, 18080a, 18086a, 18090a, 18096a, 18100a, 18106a, 18110a, and 18116a. The injected fluidic material 18200 will also pass through the radial passages, 18070d and 18070e, 18080d and 18080e, 18090d and 18090e, 18100d and 18100e, 18110d and 18110e, of the tubular pistons, 18070, 18080, 18090, 18100, and 18110, respectively, into annular piston chambers, 18202, 18204, 18206, 18208, 18208, and 18210.

[00078] As illustrated in Figs. 13B1 to 13B7, the operating pressure of the fluidic material 18200 may then be increased by, for example, controllably blocking or limiting the flow of the fluidic material through the passage 18116a and/or increasing the operating pressure of the outlet of a pumping device for injecting the fluidic material 18200 into the tension actuator assembly 18. As a result, of the increased operating pressure of the fluidic material 18200 within the tension actuator assembly 18, the operating pressures of the annular piston chambers, 18202, 18204, 18206, 18208, 18208, and 18210, will be increased sufficiently to displace the tubular pistons, 18070, 18080, 18090, 18100, and 18110, upwardly in the direction 18212 thereby also displacing the connector tube 18116. As a result, a upward tensile force is applied to all elements of the system 10 coupled to and positioned below the connector tube 18116. In an exemplary embodiment, during the upward displacement of the tubular pistons, 18070, 18080, 18090, 18100, and 18110, fluidic materials displaced by the tubular pistons within discharge annular chambers, 18214, 18216, 18218, 18220,

and 18222 are exhausted out of the tension actuator assembly 18 through the radial passages, 18008d and 18008e, 18022d and 18022e, 18030d and 18030e, 18040d and 18040e, 18050d and 18050e, respectively. Furthermore, in an exemplary embodiment, the upward displacement of the tubular pistons, 18070, 18080, 18090, 18100, and 18110, further causes the external splines 18066d of the connector tube 18066 to engage the internal splines 18014b of the tubular member 18014 and the circumferentially spaced apart teeth 18116g of the connector tube 18116 to engage the circumferentially spaced teeth 18060f of the tubular lower stop 18060. As a result of the interaction of the external splines 18066d of the connector tube 18066 to engage the internal splines 18014b of the tubular member 18014 and the circumferentially spaced apart teeth 18116g of the connector tube 18116 to engage the circumferentially spaced teeth 18060f of the tubular lower stop 18060, torsional loads may be transmitted through the tension actuator assembly 18.

[00079] In an exemplary embodiment, as illustrated in Fig. 34, a tension actuator assembly 40 includes a lower subassembly 40200 having an end that is coupled to an end of a middle subassembly 40400. A middle subassembly 40600 is coupled to the other end of the middle subassembly 40400 and includes an end that is coupled to a middle subassembly 40800. A middle subassembly 401000 is coupled to the other end of the middle subassembly 40800 and includes an end that is coupled to an upper subassembly 401200. A top subassembly 401400 is coupled to the other end of the upper subassembly 401200.

[00080] In an exemplary embodiment, as illustrated in Figs. 35A through 35C, the lower subassembly 40200 includes a tubular support or adapter 40202 that defines a longitudinal passage 40202a, and includes radial passages, 40202b and 40202c, an external threaded connection 40202d, an external shoulder 40202e, and an internal annular recess 40202f having an internal threaded connection 40202g, radial openings, 40202h, 40202i, 40202j and 40202k, and a plurality of torque lugs 40202l. The adapter 40202 further includes an external annular recess 40202m.

[00081] A plurality of torque lugs 40204a at an end of a tubular support or lower lift adapter 40204 that defines a longitudinal passage 40204b, having a variable inside diameter, and radial openings, 40204c and 40204d, and includes an external threaded connection 40204e, an external shoulder 40204f, an external annular recess 40204g and an internal threaded connection 40204h at the other end, is adapted to engage and mesh with the plurality of torque lugs 40202l of the adapter 40202 under conditions to be described. The lower lift adapter 40204 further includes an internal shoulder 40204i and blind openings, 40204j and 40204k. In an exemplary embodiment, the external annular recess 40204g may be employed to place rig elevators or slips to run or retrieve the lower subassembly 40200 in a wellbore.

[00082] An external threaded connection 40206a at an end of a tubular support or torque retainer 40206 that defines a longitudinal passage 40206b and radial openings, 40206c and 40206d, and includes an external shoulder 40206e and a plurality of torque lugs 40206f at the other end, is coupled to the internal threaded connection 40204h of the lower lift adapter 40204 so that the other end of the lower lift adapter engages or is proximate the external shoulder 40206e of the torque retainer 40206, and so that the radial openings, 40204c and 40204d, and the radial openings, 40206c and 40206d, respectively, are generally axially aligned. Torque pins, 40208a and 40208b, extend

within the generally axially aligned openings, 40204c and 40206c, and 40204d and 40206d, respectively, to lock the torque retainer 40206 to the lower lift adapter 40204.

[00083] An external threaded connection 40210a at an end of a tubular support or lower connecting rod 40210 that defines a longitudinal passage 40210b and radial openings, 40210c, 40210d, 40210e and 40210f, and includes an external threaded connection 40210g and a plurality of torque lugs 40210h at the other end, is coupled to the internal threaded connection 40202g of the adapter 40202 so that the lower connecting rod 40210 is received by and at least partially extends within the longitudinal passages 40202a, 40204b and 40206b of the adapter 40202, the lower lift adapter 40204 and the torque retainer 40206, respectively, and so that the radial openings, 40202h, 40202i, 40202j and 40202k, are generally axially aligned with the radial openings, 40210c, 40210d, 40210e and 40210f, respectively. Torque pins 40212a, 40212b, 40212c and 40212d, extend within the generally axially aligned openings, 40202h and 40210c, 40202i and 40210d, 40202j and 40210e, and 40202k and 40210f, respectively, to lock the lower connecting rod 40210 to the adapter 40202.

[00084] An annular region 40214 is defined between the outside surface of the lower connecting rod 40210 and the inside surface of the lower lift adapter 40204, and is generally axially defined between the external annular recess 40204g and the torque retainer 40206. A tubular sleeve or upper sleeve 40216 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts the internal shoulder 40204i of the lower lift adapter 40204. A cup 40218 extends within the annular region 40214 and about the lower connecting rod 40210, and includes a ring 40218a and a shoulder 40218b that abuts the upper sleeve 40216, and a distal end 40218c. An inside thimble 40220 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts and supports the cup 40218. A backup ring 40222 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts the inside thimble 40220. An outside thimble 40224 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts the backup ring 40222. A tubular sleeve 40226 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts the outside thimble 40224. A cup 40228 extends within the annular region 40214 and about the lower connecting rod 40210, and includes a ring 40228a and a shoulder 40228b that abuts the sleeve 40226, and a distal end 40228c. An inside thimble 40230 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts and supports the cup 40228. A backup ring 40232 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts the inside thimble 40230. An outside thimble 40234 extends within the annular region 40214 and about the lower connecting rod 40210, and abuts the backup ring 40232. The torque retainer 40206 abuts the outside thimble 40234 and thereby holds the sleeve 40216, the cup 40218, the inside thimble 40220, the backup ring 40222, the outside thimble 40224, the sleeve 40226, the cup 40228, the inside thimble 40230, the backup ring 40232 and the outside thimble 40234 in place within the annular region 40214.

[00085] The distal ends 40218c and 40228c of the cups 40218 and 40228, respectively, axially extend towards the adapter 40202, and the cups sealingly engage the outside surface of the lower connecting rod 40210. In an exemplary embodiment, the lower lift adapter 40204 is free to move in either axial direction relative to the lower connecting rod 40210, under conditions to be

described, while the cups 40218 and 40228 continue to sealingly engage the outside surface of the lower connecting rod 40210.

[00086] In several exemplary embodiments, the backup rings, 40222 and 40322, may be composed of Teflon and filled with glass and/or other types of materials, and/or may prevent extrusion of the cups, 40218 and 40228, during, for example, relative movement between the lower lift adapter 40204 and the lower connecting rod 40210. In an exemplary embodiment, the outside thimbles, 40224 and 40234, may be composed of steel. In several exemplary embodiments, the outside thimbles, 40224 and 40234, may be composed of bronze and/or any other bearing material suitable to prevent abrasion of the lower connecting rod 40210 during, for example, relative movement between the lower lift adapter 40204 and the lower connecting rod 40210. In an exemplary embodiment, the inside thimbles, 40220 and 40230, may be composed of steel and may provide support to the cups, 40218 and 40228.

[00087] In several exemplary embodiments, one or more cups may be added to the subassembly 40200 so that the one or more additional cups extend within the annular region 40214, with the distal ends of the additional cups axially extending towards the adapter 40202, or axially extending away from the adapter 40202 in order to, for example, act as a wiper to remove any debris from the outside surface of the lower connection rod 40210 during, for example, relative movement between the lower lift adapter 40204 and the lower connecting rod 40210. In several exemplary embodiments, for each additional cup, an inside thimble, a backup ring and an outside thimble may also be added to the subassembly 40200.

[00088] An internal threaded connection 40236a of a tubular support or coupling 40236 that defines a longitudinal passage 40236b and radial openings, 40236c and 40236d, and includes an internal annular recess 40236e having an internal threaded connection 40236f, is coupled to the external threaded connection 40210g of the lower connecting rod 40210 so that the lower connecting rod 40210 at least partially extends within the longitudinal passage 40236b. The coupling 40236 further includes a plurality of torque lugs 40236g. In several exemplary embodiments, the torque lugs 40236g are adapted to engage and mesh with the torque lugs 40206f of the torque retainer 40206 under conditions to be described.

[00089] An external threaded connection 40238a of a tubular support or lower nipple 40238 that defines a longitudinal passage 40238b and openings, 40238c and 40238d, and includes a plurality of torque lugs 40238e at an end, an external shoulder 40238f and an external threaded connection 40238g at the other end, is coupled to the internal threaded connection 40236f of the coupling 40236 so that the lower nipple 40238 at least partially extends within the longitudinal passage 40236b of the coupling 40236, the torque lugs 40238b engage and mesh with the torque lugs 40210h of the lower connecting rod 40210, and the openings, 40236c and 40236d, are generally axially aligned with the openings, 40238c and 40238d, respectively. The lower nipple 40238 further includes openings, 40238h and 40238i.

[00090] In an exemplary embodiment, the external threaded connection 40210g of the lower connecting rod 40210 and the internal threaded connection 40236a of the coupling 40236 may each be a right-hand threaded connection, and the internal threaded connection 40236f of the coupling

40236 and the external threaded connection 40238a may each be a left-hand threaded connection. The coupling 40236 may then be coupled to the lower connecting rod 40210 and the lower nipple 40238 at the same time so that, as the coupling 40236 is rotated clockwise, the threaded coupling between the external threaded connection 40210g and the internal threaded connection 40236a pulls the torque lugs 40210h towards the torque lugs 40238e, and the threaded coupling between the internal threaded connection 40236f and the external threaded connection 40238a pulls the torque lugs 40238e towards the torque lugs 40210h, until the pluralities of torque lugs 40210h and 40238e engage and mesh with each other.

[00091] Torque pins, 40240a and 40240b, extend into the generally axially aligned openings, 40236c and 40238c, and 40236d and 40238d, respectively, to lock the coupling 40236 to the lower nipple 40238.

[00092] In an exemplary embodiment, as illustrated in Figs. 36A through 36C, the middle subassembly 40400 includes a tubular support or middle lift adapter 40402 that defines a longitudinal passage 40402a, having a variable inside diameter, and radial openings, 40402b and 40402c, and includes an external threaded connection 40402d and an external shoulder 40402e at an end, an external annular recess 40402f, and an internal threaded connection 40402g at the other end. The middle lift adapter 40402 further includes an internal shoulder 40402h, an internal shoulder 40402i, and blind openings, 40402j and 40402k. In an exemplary embodiment, the external annular recess 40402f may be employed to place rig elevators or slips to run or retrieve the middle subassembly 40400 in a wellbore.

[00093] An external threaded connection 40404a of a tubular support or retainer 40404 that defines a longitudinal passage 40404b, radial openings, 40404c and 40404d, a plurality of circumferentially-spaced radial openings 40404e, one of which is shown, and a plurality of circumferentially-spaced ports 40404f, one of which is shown, that are circumferentially interspersed with the openings 40404e, and includes an external shoulder 40404g, an external shoulder 40404h and an external threaded connection 40404i, is coupled to the internal threaded connection 40402g of the middle lift adapter 40402 so that the radial openings, 40402b and 40402c, are generally axially aligned with the radial openings, 40404c and 40404d, respectively. A torque pin 40405a extends through the generally axially aligned openings 40402b and 40404c, and a torque pin 40405b extends through the generally axially aligned openings 40402c and 40404d, to lock the retainer 40404 to the middle lift adapter 40402.

[00094] An internal threaded connection 40406a at an end of a tubular support or barrel 40406 that defines a longitudinal passage 40406b, a plurality of radial openings 40406c, one of which is shown, a plurality of radial openings 40406d, one of which is shown, that are circumferentially interspersed with the openings 40406c, and includes an internal threaded connection 40406e at the other end, is coupled to the external threaded connection 40404i of the retainer 40404 so that the openings, 40404e and 40404f, are generally axially aligned with respective radial openings of the plurality of radial openings, 40406c and 40406d, respectively. The barrel 40406 further defines radial openings, 40406f and 40406g. A plurality of torque pins 40407, one of which is shown, extends through each pair of generally axially aligned openings, 40404e and 40406c, to lock the barrel 40406

to the retainer 40404.

[00095] A tubular support or connecting rod 40408 that defines a longitudinal passage 40408a, radial openings, 40408b and 40408c, and radial openings, 40408d and 40408e, and includes an external threaded connection 40408f and an external annular recess 40408g at an end, external teeth 40408h, and an external threaded connection 40408i at the other end, at least partially extends within the longitudinal passage 40402a, 40404b, 40406b of the middle lift adapter 40402, the retainer 40404 and the barrel 40406, respectively. The connecting rod 40408 further includes an external annular recess 40408j.

[00096] A retaining ring 40410 is disposed in the external annular recess 40408g and is adapted to engage the internal shoulder 40402i of the middle lift adapter 40402 to prevent the connecting rod 40408 from moving axially downward and out of the barrel 40406 during, for example, the coupling of the middle subassembly 40400 to the lower subassembly 40200.

[00097] An annular region 40412 is defined between the outside surface of the connecting rod 40408 and the inside surface of the middle lift adapter 40402, and is generally axially defined between the internal shoulder 40402h and the retainer 40404. A tubular sleeve or upper sleeve 40414 extends within the annular region 40412 and about the connecting rod 40408, and abuts the internal shoulder 40402h of the middle lift adapter 40402. A cup 40416 extends within the annular region 40412 and about the connecting rod 40408, and includes a ring 40416a and a shoulder 40416b that abuts the upper sleeve 40414, and a distal end 40416c. An inside thimble 40418 extends within the annular region 40412 and about the connecting rod 40408, and abuts and supports the cup 40416. A backup ring 40420 extends within the annular region 40412 and about the connecting rod 40408, and abuts the inside thimble 40418. An outside thimble 40422 extends within the annular region 40422 and about the connecting rod 40408, and abuts the backup ring 40420. A tubular sleeve 40424 extends within the annular region 40422 and about the connecting rod 40408, and abuts the outside thimble 40422. A cup 40426 extends within the annular region 40412 and about the connecting rod 40408, and includes a ring 40426a and a shoulder 40426b that abuts the sleeve 40424, and a distal end 40416c. An inside thimble 40428 extends within the annular region 40412 and about the connecting rod 40408, and abuts and supports the cup 40426. A backup ring 40430 extends within the annular region 40412 and about the connecting rod 40408, and abuts the inside thimble 40428. An outside thimble 40432 extends within the annular region 40422 and about the connecting rod 40408, and abuts the backup ring 40430. The retainer 40404 abuts the outside thimble 40432 and thereby holds the sleeve 40414, the cup 40416, the inside thimble 40418, the backup ring 40420, the outside thimble 40422, the sleeve 40424, the cup 40426, the inside thimble 40428, the backup ring 40430 and the outside thimble 40432 in place within the annular region 40412.

[00098] The distal ends 40416c and 40426c of the cups 40416 and 40426, respectively, axially extend towards the internal shoulder 40402h of the middle lift adapter 40402, and the cups sealingly engage the outside surface of the connecting rod 40408. In an exemplary embodiment, the middle lift adapter 40402 is free to move in either axial direction relative to the connecting rod 40408, under conditions to be described, while the cups 40416 and 40426 continue to sealingly engage the outside surface of the connecting rod 40408.

[00099] In several exemplary embodiments, the backup rings, 40420 and 40430, may be composed of Teflon and filled with glass and/or other types of materials, and/or may prevent extrusion of the cups, 40416 and 40426, during, for example, relative movement between the middle lift adapter 40402 and the connecting rod 40408. In an exemplary embodiment, the outside thimbles, 40422 and 40432, may be composed of steel. In several exemplary embodiments, the outside thimbles, 40422 and 40432, may be composed of bronze and/or any other bearing material suitable to prevent abrasion of the connecting rod 40408 during, for example, relative movement between the middle lift adapter 40402 and the connecting rod 40408. In an exemplary embodiment, the inside thimbles, 40418 and 40428, may be composed of steel and may provide support to the cups, 40416 and 40426.

[000100] Internal teeth, 40434a and 40436a, of retaining dogs, 40434 and 40436, respectively, engage and mesh with the external teeth 40408h of the connecting rod 40408. An annular region 40438 is defined between the outside surface of the connecting rod 40408 and the inside surface of the barrel 40406. An internal annular recess 40440a of an upper thimble 40440 abuts the retaining dogs, 40434 and 40436, so that the upper thimble extends within the annular region 40438 and about the connecting rod 40408.

[000101] A backup ring 40442 extends within the annular region 40438 and about the connecting rod 40408, and abuts the upper thimble 40440. An inside thimble 40444 extends within the annular region 40438 and about the connecting rod 40408, and abuts the backup ring 40442. A cup 40446 extends within the annular region 40438 and about the connecting rod 40408, includes a ring 40446a, a shoulder 40446b and a distal end 40446c, and abuts and is supported by the inside thimble 40444. A sleeve 40448 extends within the annular region 40438 and about the connecting rod 40408, and abuts the shoulder 40446b of the cup 40446. An outside thimble 40450 extends within the annular region 40438 and about the connecting rod 40408, and abuts the sleeve 40448. A backup ring 40452 extends within the annular region 40438 and about the connecting rod 40408, and abuts the outside thimble 40450. An inside thimble 40454 extends within the annular region 40438 and about the connecting rod 40408, and abuts the backup ring 40452. A cup 40456 extends within the annular region 40438 and about the connecting rod 40408, includes a ring 40456a, a shoulder 40456b and a distal end 40456c, and abuts and is supported by the inside thimble 40454. A tubular sleeve 40458 at least partially extends within the annular region 40438 and about the connecting rod 40408, and abuts the shoulder 40456b of the cup 40456.

[000102] The distal ends 40446c and 40456c of the cups 40446 and 40456, respectively, axially extend away from the internal shoulder 40402h of the middle lift adapter 40402, and the cups sealingly engage the outside surface of the connecting rod 40408. In an exemplary embodiment, the middle lift adapter 40402 is free to move in either axial direction relative to the connecting rod 40408, under conditions to be described.

[000103] In several exemplary embodiments, the backup rings, 40442 and 40452, may be composed of Teflon and filled with glass and/or other types of materials, and/or may prevent extrusion of the cups, 40446 and 40456, during, for example, relative movement between the middle lift adapter 40402 and the connecting rod 40408. In an exemplary embodiment, the outside thimbles, 40440 and 40450, may be composed of steel. In several exemplary embodiments, the outside thimbles, 40440

and 40450, may be composed of bronze and/or any other bearing material suitable to prevent abrasion of the connecting rod 40408 during, for example, relative movement between the middle lift adapter 40402 and the connecting rod 40408. In an exemplary embodiment, the inside thimbles, 40444 and 40454, may be composed of steel and may provide support to the cups, 40446 and 40456.

[000104] An internal threaded connection 40460a at an end of a tubular support or coupling 40460 that defines a longitudinal passage 40460b, radial openings, 40460c and 40460d, and radial openings, 40460e and 40460f, and includes an internal threaded connection 40460g at the other end, is coupled to the external threaded connection 40408i of the connecting rod 40408 so that the radial openings, 40460c and 40460d, are generally axially aligned with the radial openings, 40408d and 40408e, respectively, and so that the end of the coupling 40460 abuts the sleeve 40458 to hold the sleeve 40458, the cup 40456, the inside thimble 40454, the backup ring 40452, the outside thimble 40450, the sleeve 40448, the cup 40446, the inside thimble 40444, the backup ring 40442 and the upper thimble 40440 in place.

[000105] Set screws, 40462a and 40462b, extend within the openings 40460e and 40460f, respectively. A torque pin 40464a extends through the generally axially aligned radial openings 40460c and 40408d, and a torque pin 40464b extends through the generally axially aligned radial openings 40460d and 40408e, to lock the connecting rod 40408 to the coupling 40460.

[000106] In an exemplary embodiment, the middle subassemblies 40600, 40800 and 401000 are each substantially identical to the middle subassembly 40400 and therefore will not be described in detail. In the description below, any reference numeral used to refer to one or more features of one or more of the middle subassemblies 40600, 40800 and 401000 will correspond to the reference numeral for the one or more features of the middle subassembly 40400, except that the third numeral position, that is, 4, will be replaced by 6, 8 or 10 for the middle subassembly 40600, 40800 or 401000, respectively.

[000107] In an exemplary embodiment, as illustrated in Figs. 37A through 37C, the upper subassembly 401200 is substantially similar to the middle subassembly 40400. More particularly, the upper subassembly 401200 includes a tubular support or upper lift adapter 401202 that defines a longitudinal passage 401202a, having a variable inside diameter, and radial openings, 401202b and 401202c, and includes an external threaded connection 401202d and an external shoulder 401202e at an end, an external annular recess 401202f, and an internal threaded connection 401202g at the other end. The upper lift adapter 401202 further includes an internal shoulder 401202h, an internal shoulder 401202i, and blind openings, 401202j and 401202k. In an exemplary embodiment, the external annular recess 401202f may be employed to place rig elevators or slips to run or retrieve the middle subassembly 401200 in a wellbore.

[000108] An external threaded connection 401204a of a tubular support or retainer 401204 that defines a longitudinal passage 401204b, radial openings, 401204c and 401204d, a plurality of circumferentially-spaced radial openings 401204e, one of which is shown, and a plurality of circumferentially-spaced ports 401204f, one of which is shown, that are circumferentially interspersed with the openings 401204e, and includes an external shoulder 401204g, an external shoulder 401204h and an external threaded connection 401204i, is coupled to the internal threaded connection

401202g of the upper lift adapter 401202 so that the radial openings, 401202b and 401202c, are generally axially aligned with the radial openings, 401204c and 401204d, respectively. A torque pin 401205a extends through the generally axially aligned openings 401202b and 401204c, and a torque pin 401205b extends through the generally axially aligned openings 401202c and 401204d, to lock the retainer 401204 to the upper lift adapter 401202.

[000109] An internal threaded connection 401206a at an end of a tubular support or barrel 401206 that defines a longitudinal passage 401206b, a plurality of radial openings 401206c, one of which is shown, a plurality of radial openings 401206d, one of which is shown, that are circumferentially interspersed with the openings 401206c, and includes an internal threaded connection 401206e at the other end, is coupled to the external threaded connection 401204i of the retainer 401204 so that the openings, 401204e and 401204f, are generally axially aligned with respective radial openings of the plurality of radial openings, 401206c and 401206d, respectively. The barrel 401206 further defines radial openings, 401206f and 401206g. A plurality of torque pins 401207, one of which is shown, extends through each pair of generally axially aligned openings 401204e and 401206c, to lock the barrel 401206 to the retainer 401204.

[000110] A tubular support or connecting rod 401208 that defines a longitudinal passage 401208a, radial openings, 401208b and 401208c, and radial openings, 401208d and 401208e, and includes an external threaded connection 401208f and an external annular recess 401208g at an end, external teeth 401208h, and an external threaded connection 401208i at the other end, at least partially extends within the longitudinal passage 401202a, 401204b, 401206b of the upper lift adapter 401202, the retainer 401204 and the barrel 401206, respectively.

[000111] A retaining ring 401210 is disposed in the external annular recess 401208g and is adapted to engage the internal shoulder 401202i of the upper lift adapter 401202 to prevent the connecting rod 401208 from moving axially downward and completely out of the barrel 401206 during, for example, the coupling of the upper subassembly 401200 to the middle subassembly 401000.

[000112] An annular region 401212 is defined between the outside surface of the connecting rod 401208 and the inside surface of the upper lift adapter 401202, and is generally axially defined between the internal shoulder 401202h and the retainer 401204. A tubular sleeve or upper sleeve 401214 extends within the annular region 401212 and about the connecting rod 401208, and abuts the internal shoulder 401202h of the upper lift adapter 401202. A cup 401216 extends within the annular region 401212 and about the connecting rod 401208, and includes a ring 401216a and a shoulder 401216b that abuts the upper sleeve 401214, and a distal end 401216c. An inside thimble 401218 extends within the annular region 401212 and about the connecting rod 401208, and abuts and supports the cup 401216. A backup ring 401220 extends within the annular region 401212 and about the connecting rod 401208, and abuts the inside thimble 401218. An outside thimble 401222 extends within the annular region 401222 and about the connecting rod 401208, and abuts the backup ring 401220. A tubular sleeve 401224 extends within the annular region 401222 and about the connecting rod 401208, and abuts the outside thimble 401222. A cup 401226 extends within the annular region 401212 and about the connecting rod 401208, and includes a ring 401226a and a shoulder 401226b that abuts the sleeve 401224, and a distal end 401216c. An inside thimble 401228

extends within the annular region 401212 and about the connecting rod 401208, and abuts and supports the cup 401226. A backup ring 401230 extends within the annular region 401212 and about the connecting rod 401208, and abuts the inside thimble 401228. An outside thimble 401232 extends within the annular region 401222 and about the connecting rod 401208, and abuts the backup ring 401230. The retainer 401204 abuts the outside thimble 401232 and thereby holds the sleeve 401214, the cup 401216, the inside thimble 401218, the backup ring 401220, the outside thimble 401222, the sleeve 401224, the cup 401226, the inside thimble 401228, the backup ring 401230 and the outside thimble 401232 in place within the annular region 401212.

[000113] The distal ends 401216c and 401226c of the cups 401216 and 401226, respectively, axially extend towards the internal shoulder 401202h of the upper lift adapter 401202, and the cups sealingly engage the outside surface of the connecting rod 401208. In an exemplary embodiment, the upper lift adapter 401202 is free to move in either axial direction relative to the connecting rod 401208, under conditions to be described, while the cups 401216 and 401226 continue to sealingly engage the outside surface of the connecting rod 401208.

[000114] In several exemplary embodiments, the backup rings, 401220 and 401230, may be composed of Teflon and filled with glass and/or other types of materials, and/or may prevent extrusion of the cups, 401216 and 401226, during, for example, relative movement between the upper lift adapter 401202 and the connecting rod 401208. In an exemplary embodiment, the outside thimbles, 401222 and 401232, may be composed of steel. In several exemplary embodiments, the outside thimbles, 401222 and 401232, may be composed of bronze and/or any other bearing material suitable to prevent abrasion of the connecting rod 401208 during, for example, relative movement between the upper lift adapter 401202 and the connecting rod 401208. In an exemplary embodiment, the inside thimbles, 401218 and 401228, may be composed of steel and may provide support to the cups, 401216 and 401226.

[000115] Internal teeth, 401234a and 401236a, of retaining dogs, 401234 and 401236, respectively, engage and mesh with the external teeth 401208h of the connecting rod 401208. An annular region 401238 is defined between the outside surface of the connecting rod 401208 and the inside surface of the barrel 401206. An internal annular recess 401240a of an upper thimble 401240 abuts the retaining dogs, 401234 and 401236, so that the upper thimble extends within the annular region 401238 and about the connecting rod 401208.

[000116] A backup ring 401242 extends within the annular region 401238 and about the connecting rod 401208, and abuts the upper thimble 401240. An inside thimble 401244 extends within the annular region 401238 and about the connecting rod 401208, and abuts the backup ring 401242. A cup 401246 extends within the annular region 401238 and about the connecting rod 401208, includes a ring 401246a, a shoulder 401246b and a distal end 401246c, and abuts and is supported by the inside thimble 401244. A sleeve 401248 extends within the annular region 401238 and about the connecting rod 401208, and abuts the shoulder 401246b of the cup 401246. An outside thimble 401250 extends within the annular region 401238 and about the connecting rod 401208, and abuts the sleeve 401248. A backup ring 401252 extends within the annular region 401238 and about the connecting rod 401208, and abuts the outside thimble 401250. An inside

thimble 401254 extends within the annular region 401238 and about the connecting rod 401208, and abuts the backup ring 401252. A cup 401256 extends within the annular region 401238 and about the connecting rod 401208, includes a ring 401256a, a shoulder 401256b and a distal end 401256c, and abuts and is supported by the inside thimble 401254. A tubular sleeve 401258 at least partially extends within the annular region 401238 and about the connecting rod 401208, and abuts the shoulder 401256b of the cup 401256.

[000117] The distal ends 401246c and 401256c of the cups 401246 and 401256, respectively, axially extend away from the internal shoulder 401202h of the upper lift adapter 401202, and the cups sealingly engage the outside surface of the connecting rod 401208. In an exemplary embodiment, the upper lift adapter 401202 is free to move in either axial direction relative to the connecting rod 401208, under conditions to be described.

[000118] In several exemplary embodiments, the backup rings, 401242 and 401252, may be composed of Teflon and filled with glass and/or other types of materials, and/or may prevent extrusion of the cups, 401246 and 401256, during, for example, relative movement between the upper lift adapter 401202 and the connecting rod 401208. In an exemplary embodiment, the outside thimbles, 401240 and 401250, may be composed of steel. In several exemplary embodiments, the outside thimbles, 401240 and 401250, may be composed of bronze and/or any other bearing material suitable to prevent abrasion of the connecting rod 401208 during, for example, relative movement between the upper lift adapter 401202 and the connecting rod 401208. In an exemplary embodiment, the inside thimbles, 401244 and 401254, may be composed of steel and may provide support to the cups, 401246 and 401256.

[000119] An internal threaded connection 401260a at an end of a tubular support or collar 401260 that defines a longitudinal passage 401260b, radial openings, 401260c and 401260d, and radial openings, 401260e and 401260f, and includes an internal threaded connection 401260g at the other end, is coupled to the external threaded connection 401208i of the connecting rod 401208 so that the radial openings, 401260c and 401260d, are generally axially aligned with the radial openings, 401208d and 401208e, respectively, and so that the end of the collar 401260 abuts the sleeve 401258 to hold the sleeve 401258, the cup 401256, the inside thimble 401254, the backup ring 401252, the outside thimble 401250, the sleeve 401248, the cup 401246, the inside thimble 401244, the backup ring 401242 and the upper thimble 401240 in place.

[000120] Set screws, 401262a and 401262b, extend within the openings 401260e and 401260f, respectively. A torque pin 401264a extends through the generally axially aligned radial openings 401260c and 401208d, and a torque pin 401264b extends through the generally axially aligned radial openings 401260d and 401208e, to lock the connecting rod 401208 to the collar 401260.

[000121] An internal threaded connection 401266a at an end of a tubular support or guide 401266 that defines a longitudinal passage 401266b and an internal tapered surface 401266c at the other end, and includes an internal annular recess 401266d and a plurality of radial openings 401266e, is coupled to the external threaded connection 401208f of the connecting rod 401208 so that the connecting rod 401208 is at least partially received by the internal annular recess 401266d. A

plurality of fasteners 401266f, such as set screws, extend through the respective openings 401266e and into the external annular recess 410208j to lock the guide 401266 to the connecting rod 401208.

[000122] In an exemplary embodiment, as illustrated in Figs. 38A and 38B, the top subassembly 401400 includes a tubular support or top barrel 401402 that defines a longitudinal passage 401402a and includes an external annular recess 401402b, and an internal annular recess 401402c that defines an internal shoulder 401402d, and includes an internal threaded connection 401402e at an end and an external threaded connection 401402f at the other end. The top barrel 401402 further defines blind openings, 401402g and 401402h, and openings 401402i and 401402j. In an exemplary embodiment, the external annular recess 401402b may be employed to place rig elevators or slips to run or retrieve the top subassembly 401400 in a wellbore.

[000123] An internal threaded connection 401404a at an end of a tubular support or coupling 401404 that defines a longitudinal passage 401404b having a varying diameter and including a throat portion 401404c, radial openings, 401404d and 401404e, and radial openings, 401404f and 401404g at the other end, and includes an internal threaded connection 401404h at the other end, is coupled to the external threaded connection 401402f of the top barrel 401402 so that the openings, 401404d and 401404e, are generally axially aligned with the openings, 401402g and 401402h, respectively. A torque pin 401406a extends through the generally aligned openings 401404d and 401402g, and a torque pin 401406b extends through the generally aligned openings 401404e and 401402h, to lock the top barrel 401402 to the coupling 401404.

[000124] In an exemplary embodiment, as illustrated in Figs. 39A through 39T, the internal threaded connection 401404h of the coupling 401404 of the top subassembly 401400 receives and is coupled to the external threaded connection 1634g of the lower mandrel 1634 of the ball grabber assembly 16. The internal threaded connection 401402e of the top barrel 401402 of the top subassembly 401400 receives and is coupled to the external threaded connection 401202d of the upper subassembly 401200 so that the openings, 401402i and 401402j, are generally aligned with the openings, 401202j and 401202k, respectively. A torque pin 42a extends through the openings 401402i and 401202j, and a torque pin 42b extends through the openings 401402j and 401202k, to lock the top subassembly 401400 to the upper subassembly 401200.

[000125] The internal threaded connection 401260g of the collar 401260 of the upper subassembly 401200 receives and is coupled to the external threaded connection 401008f of the connecting rod 401008 of the middle subassembly 401000. The set screws, 401262a and 401262b, extend through the openings, 401260e and 401260f, respectively, and into the external annular recess 401008j to lock the collar 401260 to the connecting rod 401008. The internal threaded connection 401206e of the barrel 401206 of the upper subassembly 401200 receives and is coupled to the external threaded connection 401002d of the middle lift adapter 401002 of the middle subassembly 401000 so that the openings, 401206f and 401206g, are generally axially aligned with the openings, 401002j and 401002k, respectively. A torque pin 44a extends through the openings 401206f and 401002j, and a torque pin 44b extends through the openings 401206g and 401002k, to lock the barrel 401206 to the middle lift adapter 401002.

[000126] The internal threaded connection 401060g of the coupling 401060 of the middle

subassembly 401000 receives and is coupled to the external threaded connection 40808f of the connecting rod 40808 of the middle subassembly 40800. The set screws, 401062a and 401062b, extend through the openings, 401060e and 401060f, respectively, and into the external annular recess 40808j to lock the coupling 401060 to the connecting rod 40808. The internal threaded connection 401006e of the barrel 401006 of the middle subassembly 401000 receives and is coupled to the external threaded connection 40802d of the middle lift adapter 40802 of the middle subassembly 40800 so that the openings, 401006f and 401006g, are generally axially aligned with the openings, 40802j and 40802k, respectively. A torque pin 46a extends through the openings 401006f and 40802j, and a torque pin 46b extends through the openings 401006g and 40802k, to lock the barrel 401006 to the middle lift adapter 40802.

[000127] The internal threaded connection 40860g of the coupling 40860 of the middle subassembly 40800 receives and is coupled to the external threaded connection 40608f of the connecting rod 40608 of the middle subassembly 40600. The set screws, 40862a and 40862b, extend through the openings, 40860e and 40860f, respectively, and into the external annular recess 40608j to lock the coupling 40860 to the connecting rod 40608. The internal threaded connection 40806e of the barrel 40806 of the middle subassembly 40800 receives and is coupled to the external threaded connection 40602d of the middle lift adapter 40602 of the middle subassembly 40600 so that the openings, 40806f and 40806g, are generally axially aligned with the openings, 40602j and 40602k, respectively. A torque pin 48a extends through the openings 40806f and 40602j, and a torque pin 48b extends through the openings 40806g and 40602k, to lock the barrel 40806 to the middle lift adapter 40602.

[000128] The internal threaded connection 40660g of the coupling 40660 of the middle subassembly 40600 receives and is coupled to the external threaded connection 40406f of the connecting rod 40406 of the middle subassembly 40400. The set screws, 40662a and 40662b, extend through the openings, 40660e and 40660f, respectively, and into the external annular recess 40406j to lock the coupling 40660 to the connecting rod 40406. The internal threaded connection 40606e of the barrel 40606 of the middle subassembly 40600 receives and is coupled to the external threaded connection 40402d of the middle lift adapter 40402 of the middle subassembly 40400 so that the openings, 40606f and 40606g, are generally axially aligned with the openings, 40402j and 40402k, respectively. A torque pin 50a extends through the openings 40606f and 40402j, and a torque pin 50b extends through the openings 40606g and 40402k, to lock the barrel 40606 to the middle lift adapter 40402.

[000129] The internal threaded connection 40460g of the coupling 40460 of the middle subassembly 40400 receives and is coupled to the external threaded connection 40202d of the adapter 40202 of the lower subassembly 40200. The set screws, 40462a and 40462b, extend through the openings, 40460e and 40460f, respectively, and into the external annular recess 40202m to lock the coupling 40460 to the adapter 40202. The internal threaded connection 40406e of the barrel 40406 of the middle subassembly 40400 receives and is coupled to the external threaded connection 40204e of the lower lift adapter 40204 of the lower subassembly 40200 so that the openings, 40406f and 40406g, are generally axially aligned with the openings, 40204j and 40204k,

respectively. A torque pin 52a extends through the openings 40406f and 40204j, and a torque pin 52b extends through the openings 40406g and 40204k, to lock the barrel 40406 to the lower lift adapter 40204.

[000130] The external threaded connection 40238g of the lower nipple 40238 of the lower subassembly 40200 is received within and coupled to the internal threaded connection 20a of the end of the safety sub assembly 20 so that the openings, 40238h and 40238i, of the lower nipple 40238 are generally aligned with openings, 20b and 20c, of the safety sub assembly 20. A torque pin 54a extends through the openings 40238h and 20b, and a torque pin 54b extends through the openings 40238i and 20c, to lock the lower nipple 40238 to the safety sub assembly 20.

[000131] In several exemplary embodiments, one or more of the elements of the system 10 coupled to and positioned below the lower nipple 40238 may be removed from the system 10, or may be repositioned relative to one or more other elements of the system 10. For example, the safety sub assembly 20, the sealing cup assembly 22, the casing lock assembly 24 and the extension actuator assembly 26 may be removed from the system 10 so that the lower nipple 40238 of the lower subassembly 40200 of the tension actuator assembly 40 is directly coupled, rather than indirectly coupled, to the expansion cone assembly 28. For another example, the safety sub assembly 20, the sealing cup assembly 22, the casing lock assembly 24, the extension actuator assembly 26 and the expansion cone assembly 28 may be removed from the system 10 so that the lower nipple 40238 of the lower subassembly 40200 of the tension actuator assembly 40 is directly coupled, rather than indirectly coupled, to the expansion cone assembly 30.

[000132] In several exemplary embodiments, one or more of the above-described elements of the tension actuator assembly 40 may be omitted, at least in part, and/or combined, at least in part, with one or more other elements, or sub-elements thereof, of the tension actuator assembly 40 and/or the system 10.

[000133] In an exemplary embodiment, as illustrated in Figs. 39a through 39T, during operation of the tension actuator assembly 40, the tension actuator assembly is positioned within the casing 100. The tension actuator assembly 40 is initially placed in an extended configuration by pulling the expansion cone assembly 28 and/or the expansion cone assembly 30 against the inside surface of the casing 100 and/or against the end of the casing 100. More particularly, the tubular support member 12 is moved upwardly in a direction 56, causing the cutter assembly 14 and the ball gripper assembly 16 to also move upwardly in the direction 56, and causing the top subassembly 401400, the upper lift adapter 401202 of the upper subassembly 401200, the middle lift adapters 401002, 40802, 40602 and 40402 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively, the retainers 401004, 40804, 40604 and 40404 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively, the barrels 401006, 40806, 40606 and 40406 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively, and the lower lift adapter 40204 and the torque retainer 40206 of the lower subassembly 40200 to also move upwardly in the direction 56. As a result, the torque lugs 40204a of the lower lift adapter 40204 of the lower subassembly 40200 engage and mesh with torque lugs 40202i of the adapter 40202 of the lower subassembly. As a result of the engagement and meshing of the torque lugs 40204a with the torque lugs 40202i, the

continued movement of the tubular support 12 in the direction 56 causes all of the elements of the lower subassembly 40200, the middle subassemblies 40400, 40600, 40800 and 401000, the upper subassembly 401200, and the top subassembly 401400, to move upwardly in the direction 56 until the expansion cone assembly 28 and/or the expansion cone assembly 30 is pulled against the inside surface of the casing 100 and/or against the end of the casing 100. As a result, the tension actuator assembly 40 is in an extended configuration.

[000134] When the tension actuator assembly 40 is in its extended configuration, an axial distance 58 is defined between the end of the internal tapered surface 401266c of the guide 401266 of the upper subassembly 401200 and the internal threaded connection 401404a of the coupling 401404 of the top subassembly 401400, and an axial distance 60 is defined between the torque lugs 40206f of the torque retainer 40206 of the lower subassembly 40200 and the torque lugs 40236g of the coupling 40236 of the lower subassembly 40200. In an exemplary embodiment, the distances, 58 and 60, may be about equal to one another.

[000135] When the tension actuator assembly 40 is in its extended configuration, the engagement and meshing of the torque lugs 40204a with the torque lugs 40202l permits torque to be transmitted through the tension actuator assembly 40. For example, torque may be applied to the top subassembly 401400, thereby transmitting torque through the upper lift adapter 401202, the retainer 401204 and the barrel 401206 of the upper subassembly 401200; the middle lift adapters 401002, 40802, 40602 and 40402 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively; the retainers 401004, 40804, 40604 and 40404 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively; the barrels 401006, 40806, 40606 and 40406 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively; and the lower lift adapter 40204 of the lower subassembly 40200, due to the above-described couplings between these elements, and the torque is transmitted from the lower lift adapter 40204 to the lower connecting rod 40210 via the engagement and meshing of the torque lugs 40204a with the torque lugs 40202l and the above-described coupling of the adapter 40202 with the lower connecting rod 40210. As a result, the torque is transmitted from the lower connecting rod 40210 to one or more of the elements of the system 10 coupled to and positioned below the lower nipple 40238 via the above-described coupling between the lower connecting rod 40210 and the coupling 40236, and the coupling between the coupling 40236 and the lower nipple 40238.

[000136] In an exemplary embodiment, the ball gripper assembly 16 is operated to engage and hold the position of the casing 100, relative to the tubular support member 12, in a manner of operation substantially similar to any one of the manners of operation described and/or referenced above, and/or any combination thereof.

[000137] In an exemplary embodiment, as illustrated in Figs. 40A through 40T, during operation of the tension actuator assembly 40, and after the tension actuator assembly 40 is positioned in the casing 100, the tension actuator assembly 40 is placed in its extended configuration, and the ball gripper assembly 16 is operated, fluidic material 62 is injected into the tension actuator assembly 40 through the passages 401404b, 401402a, 401266b, 401208a, 401008a, 40808a, 40608a, 40408a, 40202a, 40210b and 40238b. The injected fluidic material 62 will also pass through

the radial openings, 401008b and 401008c, and into an adjustable annular region 64 generally defined by the inside surface of the barrel 401206 and the outside surface of the connecting rod 401008, through the radial openings, 40808b and 40808c, and into an adjustable annular region 66 generally defined by the inside surface of the barrel 401006 and the outside surface of the connecting rod 40808, through the radial openings, 40608b and 40608c, and into an adjustable annular region 68 generally defined by the inside surface of the barrel 40806 and the outside surface of the connecting rod 40608, through the radial openings, 40408b and 40408c, and into an adjustable annular region 70 generally defined by the inside surface of the barrel 40606 and the outside surface of the connecting rod 40408. The fluidic material 62 will also pass through the radial passages, 40202b and 40202c, and into an adjustable annular region 72 generally defined by the inside surface of the barrel 40406 and the outside surface of the connecting rod 40210.

[000138] In an exemplary embodiment, as illustrated in Figs. 41A through 41X, the operating pressure of the fluidic material 62 may then be increased by, for example, controllably blocking or limiting the flow of the fluidic material 62 through the passage 40238b and/or increasing the operating pressure of the outlet of a pumping device for injecting the fluidic material 62 into the tension actuator assembly 40. In an exemplary embodiment, one or more plug elements or operating plugs such as, for example, the plug 36104, may be injected into the tension actuator assembly 40 and through the passages 401404b, 401402a, 401266b, 401208a, 401008a, 40808a, 40608a, 40408a, 40202a, 40210b and 40238b, and the internal tapered surface 401266c of the guide 401266 may facilitate the guiding of the plug 36104 into the passage 401208a of the connecting rod 401208.

[000139] As a result of the increased operating pressure of the fluidic material 62, the operating pressure within each of the annular regions 64, 66, 68, 70 and 72 is increased so that the total of the forces generated within each of the annular regions is sufficient to displace the guide 401266, the connecting rod 401208, the retaining dogs 401234 and 401236, the upper thimble 401240, the backup ring 401242, the inside thimble 401244, the cup 401246, the sleeve 401248, the outside thimble 401250, the backup ring 401252, the inside thimble 401254, the cup 401256, the tubular sleeve 401258 and the collar 401260 of the upper subassembly 401200 in an upward direction 74. During this displacement, the upper lift adapter 401202, the retainer 401204, the barrel 401206, the upper sleeve 401214, the cup 401216, the inside thimble 401218, the backup ring 401220, the outside thimble 401222, the sleeve 401222, the cup 401226, the inside thimble 401228, the backup ring 401230 and the outside thimble 401232 remain stationary, the volumetric space or size of the annular region 64 increases, the cups 401216 and 401226 continue to sealingly engage the outside surface of the connecting rod 401208, and the cups 401246 and 401256 continue to sealingly engage the inside surface of the barrel 401206.

[000140] Moreover, the connecting rod 401008, the retaining dogs 401034 and 401036, the upper thimble 401040, the backup ring 401042, the inside thimble 401044, the cup 401046, the sleeve 401048, the outside thimble 401050, the backup ring 401052, the inside thimble 401054, the cup 401056, the tubular sleeve 401058 and the coupling 401060 of the middle subassembly 40100 are also displaced in the upward direction 74. During this displacement, the middle lift adapter 401002, the retainer 401004, the barrel 401006, the upper sleeve 401014, the cup 401016, the inside

thimble 401018, the backup ring 401020, the outside thimble 401022, the sleeve 401022, the cup 401026, the inside thimble 401028, the backup ring 401030 and the outside thimble 401032 remain stationary, the volumetric space or size of the annular region 64 increases as noted above, the cups 401016 and 401026 continue to sealingly engage the outside surface of the connecting rod 401008, and the cups 401046 and 401056 continue to sealingly engage the inside surface of the barrel 401006.

[000141] Moreover, the connecting rod 40808, the retaining dogs 40834 and 40836, the upper thimble 40840, the backup ring 40842, the inside thimble 40844, the cup 40846, the sleeve 40848, the outside thimble 40850, the backup ring 40852, the inside thimble 40854, the cup 40856, the tubular sleeve 40858 and the coupling 40860 of the middle subassembly 40800 are also displaced in the upward direction 74. During this displacement, the middle lift adapter 40802, the retainer 40804, the barrel 40806, the upper sleeve 40814, the cup 40816, the inside thimble 40818, the backup ring 40820, the outside thimble 40822, the sleeve 40822, the cup 40826, the inside thimble 40828, the backup ring 40830 and the outside thimble 40832 remain stationary, the volumetric space or size of the annular region 66 increases, the cups 40816 and 40826 continue to sealingly engage the outside surface of the connecting rod 40808, and the cups 40846 and 40856 continue to sealingly engage the inside surface of the barrel 40806.

[000142] Moreover, the connecting rod 40608, the retaining dogs 40634 and 40636, the upper thimble 40640, the backup ring 40642, the inside thimble 40644, the cup 40646, the sleeve 40648, the outside thimble 40650, the backup ring 40652, the inside thimble 40654, the cup 40656, the tubular sleeve 40658 and the coupling 40660 of the middle subassembly 40600 are also displaced in the upward direction 74. During this displacement, the middle lift adapter 40602, the retainer 40604, the barrel 40606, the upper sleeve 40614, the cup 40616, the inside thimble 40618, the backup ring 40620, the outside thimble 40622, the sleeve 40622, the cup 40626, the inside thimble 40628, the backup ring 40630 and the outside thimble 40632 remain stationary, the volumetric space or size of the annular region 68 increases, the cups 40616 and 40626 continue to sealingly engage the outside surface of the connecting rod 40608, and the cups 40646 and 40656 continue to sealingly engage the inside surface of the barrel 40606.

[000143] Moreover, the connecting rod 40408, the retaining dogs 40434 and 40436, the upper thimble 40440, the backup ring 40442, the inside thimble 40444, the cup 40446, the sleeve 40448, the outside thimble 40450, the backup ring 40452, the inside thimble 40454, the cup 40456, the tubular sleeve 40458 and the coupling 40460 of the middle subassembly 40400 are also displaced in the upward direction 74. During this displacement, the middle lift adapter 40402, the retainer 40404, the barrel 40406, the upper sleeve 40414, the cup 40416, the inside thimble 40418, the backup ring 40420, the outside thimble 40422, the sleeve 40422, the cup 40426, the inside thimble 40428, the backup ring 40430 and the outside thimble 40432 remain stationary, the volumetric space or size of the annular region 70 increases, the cups 40416 and 40426 continue to sealingly engage the outside surface of the connecting rod 40408, and the cups 40446 and 40456 continue to sealingly engage the inside surface of the barrel 40406.

[000144] Moreover, the adapter 40202, the connecting rod 40210, the coupling 40236 and the lower nipple 40238 of the lower subassembly 40200 are also displaced in the upward direction 74. During this displacement, the lower lift adapter 40204, the upper sleeve 40216, the cup 40218, the inside thimble 40220, the backup ring 40222, the outside thimble 40224, the sleeve 40226, the cup 40228, the inside thimble 40230, the backup ring 40232, the outside thimble 40234 and the torque retainer 40206 remain stationary, the volumetric space or size of the annular region 72 increases, and the cups 40218 and 40228 continue to sealingly engage the outside surface of the connecting rod 40210.

[000145] During the above-described displacement of several components of the tension actuator assembly 40 in the direction 74, an upward tensile force is applied to all elements of the system 10 coupled to and positioned below the lower nipple 40238. As a result, the expansion cone assembly 28 and/or 30 radially expands and plastically deforms at least a portion of the casing 100, in a manner of operation substantially similar to any of the manners of operation of the expansion cone assembly 28 and/or 30 described and/or referenced above, and/or any combination thereof.

[000146] As a result of the above-described displacement of several components of the tension actuator assembly 40 in the direction 74, the tension actuator assembly 40 is in a retracted configuration. In an exemplary embodiment, when the tension actuator assembly 40 is in a retracted configuration, the torque lugs 40206f engage and mesh with the torque lugs 40236g, and the respective values of the distances 58 and 60 are negligible, that is, equal to, or nearly equal to, zero. In an exemplary embodiment, when the distances 58 and 60 are each about equal to the other when the tension actuator assembly 40 is in the extended configuration, and when the distances 58 and 60 are each negligible when the tension actuator assembly 40 is in the retracted configuration, the distances 58 and 60 are each about equal to the stroke length of the tension actuator assembly 40 when the tension actuator assembly 40 is in the extended configuration; that is, the stroke length of the tension actuator assembly 40 is about equal to the overall axial distance that each of the connecting rods 401208, 401008, 40808, 40608, 40408 and 40210 travels during the above-described displacement of several components of the tension actuator assembly 40 in the direction 74.

[000147] In an exemplary embodiment, the stroke length of the tension actuator assembly 40 may be about 35 feet. In several exemplary embodiments, the casing 100 may be in the form of a wide variety of types and configurations of casing, including a wide variety of sizes of casing. In an exemplary embodiment, the casing 100 may be, for example, 7-5/8 inch casing. In an exemplary embodiment, the transportable length of each of the above-described subassemblies 40200, 40400, 40600, 40800, 401000, 401200 and 401400 in the tension actuator assembly 40 may be, for example, equal to or less than about 45 feet.

[000148] In an exemplary embodiment, the stroke length of the tension actuator assembly 40 may be increased by coupling, with flush joint connections, connecting-rod extensions and barrel extensions between, for example, the lower subassembly 40200 and the middle subassembly 40400, the middle subassembly 40400 and the middle subassembly 40600, the middle subassembly 40600 and the middle subassembly 40800, the middle subassembly 40800 and the middle subassembly

401000, and the middle subassembly 401000 and the upper subassembly 401200, of the tension actuator assembly 40. In an exemplary embodiment, the stroke length of the tension actuator assembly 40 may be increased up to, for example, 90 feet. In an exemplary embodiment, a connecting-rod extension may be coupled to the lower connecting rod 40210 of the lower subassembly 40200, a connecting-rod extension may be coupled to each of the connecting rods 40408, 40608, 40808 and 401008, a barrel extension may be coupled to each of the barrels 40406, 40606, 40806 and 401006, and a barrel extension may be coupled to the barrel 401206. In an exemplary embodiment, the stroke length of the tension actuator assembly 40 may be increased up to, for example, 90 feet, while the transportable length of each of the above-described subassemblies 40200, 40400, 40600, 40800, 401000, 401200 and 401400 in the tension actuator assembly 40 may be, for example, equal to or less than about 45 feet.

[000149] When the tension actuator assembly 40 is in its retracted configuration, the engagement and meshing of the torque lugs 40206f with the torque lugs 40236g permits torque to be transmitted through the tension actuator assembly 40. For example, torque may be applied to the top subassembly 401400, thereby transmitting torque through the upper lift adapter 401202, the retainer 401204 and the barrel 401206 of the upper subassembly 401200; the middle lift adapters 401002, 40802, 40602 and 40402 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively; the retainers 401004, 40804, 40604 and 40404 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively; the barrels 401006, 40806, 40606 and 40406 of the middle subassemblies 401000, 40800, 40600 and 40400, respectively; and the lower lift adapter 40204 and the torque retainer 40206 of the lower subassembly 40200, due to the above-described couplings between these elements, and the torque is transmitted from the torque retainer 40206 to the coupling 40236 via the engagement and meshing of the torque lugs 40206f with the torque lugs 40236g. As a result, the torque is transmitted from the coupling 40236 to one or more elements of the system 10 coupled to and positioned below the lower nipple 40238 via the above-described coupling between the coupling 40236 and the lower nipple 40238. The torque may also be transmitted from the coupling 40236 to the lower connecting rod 40210 via the above-described coupling between the coupling 40236 and the lower connecting rod 40210.

[000150] In an exemplary embodiment, after the tension actuator assembly 40 has been placed in its retracted configuration from its extended configuration, thereby causing radial expansion and plastic deformation of the casing 100 as described above, the ball gripper assembly 16 may then be operated to release the casing 100, and the tubular support 12 may be moved upwardly to permit the tension actuator assembly 40 to again be placed in its extended configuration. The above-described operation of the tension actuator assembly 40 may then be repeated to radially expand and plastically deform at least another portion of the casing 100. As a result, in an exemplary embodiment, the casing 100 may be radially expanded and plastically deformed without subjecting the casing 100 to the increased operating pressure of the fluidic material 62, and/or the increased operating pressure within each of the annular regions 64, 66, 68, 70 and 72. As a result, in an exemplary embodiment, the casing 100 may be generally prevented from bursting in response to the increased operating pressure of the fluidic material 62, and/or the increased operating pressure within

each of the annular regions 64, 66, 68, 70 and 72, especially if the increased operating pressure of the fluidic material 62, and/or the increased operating pressure within each of the annular regions 64, 66, 68, 70 and 72, is higher than the burst pressure of the casing 100 and/or is higher than the pressure rating of the casing connections in the casing 100. As another result, in an exemplary embodiment, the radial expansion and plastic deformation of the casing 100 does not require the casing 100 to maintain pressure integrity. That is, the tension actuator assembly 40 may be operated to radially expand and plastically deform the casing 100 even if the casing 100 has lost pressure integrity, or has negligible pressure integrity, due to, for example, one or more holes or openings in the casing 100, one or more parted portions of the casing 100 and/or other causes.

[000151] In several exemplary embodiments, during the operation of the tension actuator assembly 40, the ball gripper assembly 16 may or may not be operated to engage the casing 100. In several exemplary embodiments, slips may be substituted for the ball gripper assembly 16.

[000152] In several exemplary embodiments, during the operation of the tension actuator assembly 40 and, in particular, the placement of the tension actuator assembly 40 in its retracted configuration from its extended configuration, the use of the above-described cups 401246 and 401256, 401046 and 401056, 40846 and 40856, 40646 and 40656, and 40446 and 40456, to sealingly engage the inside surfaces of the barrels 401206, 401006, 40806, 40606 and 40406, respectively, permits the use of a non-machined finish on these inside surfaces with no special coatings. In an exemplary embodiment, in addition to, or instead of the cups 401246 and 401256, 401046 and 401056, 40846 and 40856, 40646 and 40656, and 40446 and 40456, other seal systems such as, for example, V-packing, may be used when, for example, the inside surfaces of the barrels 401206, 401006, 40806, 40606 and 40406 are machined to a seal finish and/or are coated or plated with an abrasion-resistant material.

[000153] In several exemplary embodiments, during the operation of the tension actuator assembly 40 and, in particular, the placement of the tension actuator assembly 40 in its retracted configuration from its extended configuration, the use of the above-described cups 401216 and 401226, 401016 and 401026, 40816 and 40826, 40616 and 40626, 40416 and 40426, and 40218 and 40228, to sealingly engage the outside surfaces of the connecting rods 401208, 401008, 40808, 40608, 40408 and 40210, respectively, permits the use of a non-machined finish on these outside surfaces with no special coatings. In an exemplary embodiment, in addition to, or instead of the cups 401216 and 401226, 401016 and 401026, 40816 and 40826, 40616 and 40626, 40416 and 40426, and 40218 and 40228, other seal systems such as, for example, V-packing, may be used when, for example, the outside surfaces of the connecting rods 401208, 401008, 40808, 40608, 40408 and 40210 are machined to a seal finish and/or are coated or plated with an abrasion-resistant material.

[000154] In an exemplary embodiment, as illustrated in Figs. 42A and 42B, a device 80 includes a generally partially cylindrical body 80a defining an end surface 80b, and an opening 80c formed in the body 80a and defining an internal arcuate surface 80ca and parallel-spaced surfaces 80cb and 80cc extending from the internal arcuate surface 80ca. An internal recess 80d is formed in the body 80a and defines an internal arcuate surface 80da and parallel-spaced surfaces 80db and 80dc extending from the internal arcuate surface 80da, and further defines an internal shoulder 80e.

Circumferentially-spaced and aligned counterbores 80f and 80g having internal threaded connections 80fa and 80ga, respectively, extend through the body 80a, and set screws 80ha and 80hb extend through the counterbores 80f and 80g, respectively, and threadably engage the internal threaded connections 80fa and 80ga, respectively. Handles 80ia and 80ib are connected to the surface 80b. In an exemplary embodiment, the handles 80i and 80ib may each be connected to the surface 80b via one or more weld joints.

[000155] In an exemplary embodiment, as illustrated in Fig. 43, the device 80 may be coupled to the middle subassembly 40400. When the device 80 is coupled to the middle subassembly 40400, the device 80 is positioned so that the barrel 40406 at least partially extends within the internal recess 80d of the device 80, and the coupling 40460 at least partially extends within the opening 80c. As a result, the internal shoulder 80e is adjacent the barrel 40406 and the surface 80b is adjacent the coupling 40460. The set screws 80ha and 80hb extend through the radial openings 40406f and 40406g, respectively, of the barrel 40406, thereby holding the device 80 in place.

[000156] In several exemplary embodiments, the device 80 may be coupled to each of the middle subassemblies 40600, 40800 and 40100 in a manner identical to the manner in which the device 80 is coupled to the middle subassembly 40400, as described above.

[000157] In an exemplary embodiment, as illustrated in Fig. 44, the device 80 may be coupled to the upper subassembly 401200. When the device 80 is coupled to the upper subassembly 401200, the device 80 is positioned so that the barrel 401206 at least partially extends within the internal recess 80d of the device 80, and the collar 401260 at least partially extends within the opening 80c. As a result, the internal shoulder 80e is adjacent the barrel 401260 and the surface 80b is adjacent the collar 401260. The set screws 80ha and 80hb extend through the radial openings 401206f and 401206g, respectively, of the barrel 401206, thereby holding the device 80 in place.

[000158] In an exemplary embodiment, the lower subassembly 40200, the middle subassemblies 40400, 40600, 40800 and 401000, the upper subassembly 401200 and the top subassembly 401400 may each be transported to the vicinity of the wellbore 102 by, for example, a truck, and may then be coupled together in the above-described manner on, for example, a rig floor.

[000159] In an exemplary embodiment, the tension actuator assembly 40 may be positioned in the casing 100, in order to operate the tension actuator assembly 40 as described above, by first running the lower subassembly 40200 in the wellbore 102. The middle subassembly 40400 is then coupled to the lower subassembly 40200. In an exemplary embodiment, the device 80 may be coupled to the middle subassembly 40400, in the manner described above, before the middle subassembly 40400 is coupled to the lower subassembly 40200. As a result, the device 80 is held in place, relative to the barrel 40406 of the middle subassembly 40400, and serves as a safety device, preventing the middle lift adapter 40402, the retainer 40404 and the barrel 40406 from accidentally moving downward during the coupling of the middle subassembly 40400 to the lower subassembly 40200, and/or the coupling of any one or more elements of the system 10 positioned below the middle subassembly 40400 to any one or more other elements of the system 10 positioned below the middle subassembly 40400. The device 80 is decoupled from the middle subassembly 40400 during or after the middle subassembly 40400 is coupled to the lower subassembly 40200.

[000160] The middle lift adapter 40402, the retainer 40404 and the barrel 40406 of the middle subassembly 40400 are then lowered, and the middle subassembly 40600 is coupled to the middle subassembly 40400. In an exemplary embodiment, the device 80 may be coupled to the middle subassembly 40600, in the manner described above, before the middle subassembly 40600 is coupled to the middle subassembly 40400. As a result, the device 80 is held in place, relative to the barrel 40606 of the middle subassembly 40600, and serves as a safety device, preventing the middle lift adapter 40602, the retainer 40604 and the barrel 40606 from accidentally moving downward during the coupling of the middle subassembly 40600 to the middle subassembly 40400, and/or the coupling of any one or more elements of the system 10 positioned below the middle subassembly 40600 to any one or more other elements of the system 10 positioned below the middle subassembly 40600. The device 80 is decoupled from the middle subassembly 40600 during or after the middle subassembly 40600 is coupled to the middle subassembly 40400. The middle subassembly 40400 is lowered into the wellbore 102.

[000161] The middle lift adapter 40602, the retainer 40604 and the barrel 40606 of the middle subassembly 40600 are then lowered, and the middle subassembly 40800 is coupled to the middle subassembly 40600. In an exemplary embodiment, the device 80 may be coupled to the middle subassembly 40800, in the manner described above, before the middle subassembly 40800 is coupled to the middle subassembly 40600. As a result, the device 80 is held in place, relative to the barrel 40806 of the middle subassembly 40800, and serves as a safety device, preventing the middle lift adapter 40802, the retainer 40804 and the barrel 40806 from accidentally moving downward during the coupling of the middle subassembly 40800 to the middle subassembly 40600, and/or the coupling of any one or more elements of the system 10 positioned below the middle subassembly 40800 to any one or more other elements of the system 10 positioned below the middle subassembly 40800. The device 80 is decoupled from the middle subassembly 40800 during or after the middle subassembly 40800 is coupled to the middle subassembly 40600. The middle subassembly 40600 is lowered into the wellbore 102.

[000162] The middle subassembly 401000 is coupled to the middle subassembly 40800, and the middle subassembly 40800 is lowered into the wellbore 102, in manners similar to the manners in which the middle subassembly 40800 is coupled to the middle subassembly 40600, and the middle subassembly 40600 is lowered into the wellbore 102, respectively, as described above. The upper subassembly 401200 is coupled to the middle subassembly 401000, and the middle subassembly 401000 is lowered into the wellbore 102, in manners similar to the manners in which the middle subassembly 40800 is coupled to the middle subassembly 40600, and the middle subassembly 40600 is lowered into the wellbore 102, respectively, as described above. The top subassembly 401400 is coupled to the upper subassembly 401200, and the upper subassembly 401200 is lowered into the wellbore 102. The top subassembly 401400 is lowered into the wellbore 102. As a result, the tension actuator assembly 40 is positioned in the casing 100.

[000163] In several exemplary embodiments, and instead of the above-described positioning procedure, the tension actuator assembly 40 may be positioned in the casing 100 using a wide variety

of techniques, steps, procedures, and/or combinations thereof, including, for example, any positioning techniques, steps and/or procedures described and/or referenced above.

[000164] In an exemplary embodiment, another ball grabber assembly such as, for example, any of the ball grabber assemblies described and/or referenced above, and at least one other tension actuator assembly such as, for example, a tension actuator assembly similar to the tension actuator assembly 18, may be run between the tension actuator assembly 40 and the expansion cone assemblies 28 and/or 30. As a result, and during operation of the system 10, if the ball grabber assembly 16 above the tension actuator assembly 40 is positioned outside of the unexpanded portion of the casing 100 when, for example, the radial expansion and plastic deformation of the casing 100 is almost completed, and, as a result, the ball grabber assembly 16 is not able to operate in one or more of the manners described and/or referenced above, the at least one other tension actuator assembly may be operated to complete the radial expansion and plastic deformation of the casing 100.

[000165] A method has been described that includes positioning an actuator assembly in a tubular member, the actuator assembly comprising one or more adjustable annular regions; placing the actuator assembly in a first configuration; and placing the actuator assembly in a second configuration, comprising pressurizing the one or more adjustable annular regions. In an exemplary embodiment, the method comprises radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration. In an exemplary embodiment, the method comprises coupling the actuator assembly to an expansion device. In an exemplary embodiment, the method comprises displacing the expansion device to radially expand and plastically deform at least a portion of the tubular member during placing the actuator assembly in the second configuration. In an exemplary embodiment, pressurizing the one or more adjustable annular regions comprises fluidically pressurizing the one or more adjustable annular regions. In an exemplary embodiment, the actuator assembly comprises one or more first tubular supports; and one or more second tubular supports at least partially extending within the one or more first tubular supports; wherein the one or more adjustable annular regions are at least partially defined between the one or more first tubular supports and the one or more second tubular supports. In an exemplary embodiment, placing the actuator assembly in the second configuration comprises displacing the one or more second tubular supports relative to the one or more first tubular supports in response to pressurizing the one or more adjustable annular regions. In an exemplary embodiment, pressurizing the one or more adjustable annular regions comprises fluidically pressurizing the one or more adjustable annular regions. In an exemplary embodiment, fluidically pressurizing the one or more adjustable annular regions comprises introducing fluidic material into one or more passages defined by the one or more second tubular supports; and permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions. In an exemplary embodiment, fluidically pressurizing the one or more adjustable annular regions further comprises sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements; and sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements. In an exemplary embodiment, each of the one or more first sealing elements and the one or second sealing elements comprises a cup. In an exemplary

embodiment, the actuator assembly comprises at least five adjustable annular regions. In an exemplary embodiment, the method comprises transmitting torque through the actuator assembly. In an exemplary embodiment, the method comprises transmitting torque through the actuator assembly in the first configuration. In an exemplary embodiment, the method comprises transmitting torque through the actuator assembly in the second configuration. In an exemplary embodiment, the method comprises transmitting torque through the actuator assembly in the first configuration; and transmitting torque through the actuator assembly in the second configuration. In an exemplary embodiment, the method comprises coupling a gripping device to the actuator assembly. In an exemplary embodiment, placing the actuator assembly in the second configuration comprises gripping the tubular member using the gripping device.

[000166] A method has been described that includes positioning an actuator assembly in a tubular member, the actuator assembly comprising one or more first tubular supports; one or more second tubular supports at least partially extending within the one or more first tubular supports; and one or more adjustable annular regions at least partially defined between the one or more first tubular supports and the one or more second tubular supports; placing the actuator assembly in a first configuration; and placing the actuator assembly in a second configuration, comprising fluidically pressurizing the one or more adjustable annular regions, comprising sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements; sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements; introducing fluidic material into one or more passages defined by the one or more second tubular supports; and permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions; and displacing the one or more second tubular supports relative to the one or more first tubular supports in response to fluidically pressurizing the one or more adjustable annular regions; coupling the actuator assembly to an expansion device; radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration, comprising displacing the expansion device to radially expand and plastically deform the at least a portion of the tubular member during placing the actuator assembly in the second configuration; permitting torque to be transmitted through the actuator assembly in the first configuration; permitting torque to be transmitted through the actuator assembly in the second configuration; and coupling a gripping device to the actuator assembly; wherein placing the actuator assembly in the second configuration comprises gripping the tubular member using the gripping device.

[000167] A system has been described that includes means for positioning an actuator assembly in a tubular member, the actuator assembly comprising one or more adjustable annular regions; means for placing the actuator assembly in a first configuration; and means for placing the actuator assembly in a second configuration, comprising means for pressurizing the one or more adjustable annular regions. In an exemplary embodiment, the system comprises means for radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration. In an exemplary embodiment, the system comprises means for coupling the actuator assembly to an expansion device. In an exemplary embodiment, the

system comprises means for displacing the expansion device to radially expand and plastically deform at least a portion of the tubular member during placing the actuator assembly in the second configuration. In an exemplary embodiment, means for pressurizing the one or more adjustable annular regions comprises means for fluidically pressurizing the one or more adjustable annular regions. In an exemplary embodiment, the actuator assembly comprises one or more first tubular supports; and one or more second tubular supports at least partially extending within the one or more first tubular supports; wherein the one or more adjustable annular regions are at least partially defined between the one or more first tubular supports and the one or more second tubular supports. In an exemplary embodiment, the system comprises means for placing the actuator assembly in the second configuration comprises means for displacing the one or more second tubular supports relative to the one or more first tubular supports in response to pressurizing the one or more adjustable annular regions. In an exemplary embodiment, means for pressurizing the one or more adjustable annular regions comprises fluidically pressurizing the one or more adjustable annular regions. In an exemplary embodiment, means for fluidically pressurizing the one or more adjustable annular regions comprises means for introducing fluidic material into one or more passages defined by the one or more second tubular supports; and means for permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions. In an exemplary embodiment, means for fluidically pressurizing the one or more adjustable annular regions further comprises means for sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements; and means for sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements. In an exemplary embodiment, each of the one or more first sealing elements and the one or second sealing elements comprises a cup. In an exemplary embodiment, the actuator assembly comprises at least five adjustable annular regions. In an exemplary embodiment, the system comprises means for transmitting torque through the actuator assembly. In an exemplary embodiment, the system comprises means for transmitting torque through the actuator assembly in the first configuration. In an exemplary embodiment, the system comprises means for transmitting torque through the actuator assembly in the second configuration. In an exemplary embodiment, the system comprises transmitting torque through the actuator assembly in the first configuration; and transmitting torque through the actuator assembly in the second configuration. In an exemplary embodiment, the system comprises means for coupling a gripping device to the actuator assembly. In an exemplary embodiment, means for placing the actuator assembly in the second configuration comprises means for gripping the tubular member using the gripping device.

[000168] A system has been described that includes means for positioning an actuator assembly in a tubular member, the actuator assembly comprising one or more first tubular supports; one or more second tubular supports at least partially extending within the one or more first tubular supports; and one or more adjustable annular regions at least partially defined between the one or more first tubular supports and the one or more second tubular supports; means for placing the actuator assembly in a first configuration; and means for placing the actuator assembly in a second configuration, comprising means for fluidically pressurizing the one or more adjustable annular regions,

comprising means for sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements; means for sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements; means for introducing fluidic material into one or more passages defined by the one or more second tubular supports; and means for permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions; and means for displacing the one or more second tubular supports relative to the one or more first tubular supports in response to fluidically pressurizing the one or more adjustable annular regions; means for coupling the actuator assembly to an expansion device; means for radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration, comprising means for displacing the expansion device to radially expand and plastically deform the at least a portion of the tubular member during placing the actuator assembly in the second configuration; means for permitting torque to be transmitted through the actuator assembly in the first configuration; means for permitting torque to be transmitted through the actuator assembly in the second configuration; and means for coupling a gripping device to the actuator assembly; wherein means for placing the actuator assembly in the second configuration comprises means for gripping the tubular member using the gripping device.

[000169] An apparatus has been described that includes an actuator assembly comprising at least one first tubular support; at least one second tubular support: at least partially extending within the at least one first tubular support, the at least one second tubular support is movable between a first position and a second position; and at least one adjustable annular region at least partially defined between the at least one first tubular support and the at least one second tubular support and adapted to be pressurized; wherein the at least one second tubular support is placed in the second position from the first position in response to the pressurization of the at least one adjustable annular region. In an exemplary embodiment, the actuator assembly further comprises at least one first sealing element sealingly engaging the outside surface of the at least one second tubular support; and at least one second sealing element coupled to the at least one second tubular support and sealingly engaging the inside surface of the at least one first tubular support. In an exemplary embodiment, at least one adjustable annular region is at least partially defined by the at least one second sealing element. In an exemplary embodiment, at least one second sealing element is movable between a first position and a second position to adjust the size of the at least one adjustable annular region; and wherein the at least one first sealing element remains stationary during the movement of the at least one second sealing element between the first and second positions. In an exemplary embodiment, each of the at least one first sealing element and the at least one second sealing element comprises a cup. In an exemplary embodiment, a passage is defined by the at least one second tubular support. In an exemplary embodiment, at least one second tubular support comprises at least one radial opening via which the passage defined by the at least one second tubular support is in fluid communication with the at least one adjustable annular region. In an exemplary embodiment, the actuator assembly further comprises one or more torque lugs for transmitting torque through the actuator assembly. In an exemplary embodiment, the actuator

assembly further comprises one or more first torque lugs for transmitting torque through the actuator assembly when the at least one second tubular support is in the first position; and one or more second torque lugs for transmitting torque through the actuator assembly when the at least one second tubular support is in the second position. In an exemplary embodiment, the apparatus comprises an expansion device coupled to the actuator assembly; wherein the expansion device moves in response to the movement of the at least one second tubular support between the first and second positions. In an exemplary embodiment, the apparatus comprises a gripping device coupled to the actuator assembly. In an exemplary embodiment, the actuator assembly comprises a plurality of first tubular supports, each first tubular support in the plurality of first tubular supports is coupled to at least one other first tubular support in the plurality of first tubular supports; and a plurality of second tubular supports, each second tubular support in the plurality of second tubular supports at least partially extends within at least one first tubular support in the plurality of first tubular supports. In an exemplary embodiment, the actuator assembly comprises a plurality of adjustable annular regions; wherein each adjustable annular region in the plurality of adjustable annular regions is at least partially defined between one first tubular support in the plurality of first tubular supports and one second tubular support in the plurality of second tubular supports. In an exemplary embodiment, the plurality of adjustable annular regions comprises at least five adjustable annular regions.

[000170] An apparatus has been described that includes an actuator assembly comprising at least one first tubular support; at least one second tubular support at least partially extending within the at least one first tubular support, the at least one second tubular support is movable between a first position and a second position; at least one first sealing element sealingly engaging the outside surface of the at least one second tubular support; at least one second sealing element coupled to the at least one second tubular support and sealingly engaging the inside surface of the at least one first tubular support; at least one adjustable annular region at least partially defined between the at least one first tubular support and the at least one second tubular support and adapted to be pressurized; wherein the at least one second tubular support is placed in the second position from the first position in response to the pressurization of the at least one adjustable annular region; wherein the at least one adjustable annular region is at least partially defined by the at least one second sealing element; wherein the at least one second sealing element is movable between a first position and a second position to adjust the size of the at least one adjustable annular region; wherein the at least one first sealing element remains stationary during the movement of the at least one second sealing element between the first and second positions; wherein each of the at least one first sealing element and the at least one second sealing element comprises a cup; wherein a passage is defined by the at least one second tubular support; wherein the at least one second tubular support comprises at least one radial opening via which the passage defined by the at least one second tubular support is in fluid communication with the at least one adjustable annular region; and wherein the actuator assembly further comprises one or more first torque lugs for transmitting torque through the actuator assembly when the at least one second tubular support is in the first position; and one or more second torque lugs for transmitting torque through the actuator assembly when the at least one second tubular support is in the second position; and wherein the apparatus further comprises an expansion device

coupled to the actuator assembly, the expansion device moves in response to the movement of the at least one second tubular support between the first and second positions; and a gripping device coupled to the actuator assembly.

[000171] A device has been described that is adapted to be coupled to a first tubular support within which a second tubular support at least partially extends, the device comprising a body member; an opening in the body member within which the second tubular support is adapted to at least partially extend when the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support is adapted to at least partially extend when the device is coupled to the first tubular support. In an exemplary embodiment, the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, movement of the first tubular support, in an axial direction and relative to the second tubular support, is generally prevented when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, the body member defines an end surface with which at least a portion of the second tubular support is adjacent when the second tubular support at least partially extends within the opening. In an exemplary embodiment, movement of the second tubular support, in another axial direction and relative to the first tubular support, is generally prevented when the device is coupled to the first tubular support, the first tubular support at least partially extends within the internal recess and the second tubular support at least partially extends within the opening. In an exemplary embodiment, the device comprises first and second bores formed through the body member; and first and second fasteners extending through the first and second bores, respectively, and into the internal recess. In an exemplary embodiment, the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member. In an exemplary embodiment, the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member. In an exemplary embodiment, the device comprises one or more handles connected to the body member.

[000172] A device has been described that is adapted to be coupled to a first tubular support within which a second tubular support at least partially extends, the device comprising a body member; an opening in the body member within which the second tubular support is adapted to at least partially extend when the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support is adapted to at least partially extend when the device is coupled to the first tubular support; wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein movement of

the first tubular support, in an axial direction and relative to the second tubular support, is generally prevented when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein the device further comprises first and second bores formed through the body member; first and second fasteners extending through the first and second bores, respectively, and into the internal recess; and one or more handles connected to the body member; wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member; and wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.

[000173] A method has been described that includes assembling a tension actuator assembly, comprising coupling at least one subassembly to at least one other subassembly; and positioning the tension actuator assembly within a wellbore. In an exemplary embodiment, positioning the tension actuator assembly within the wellbore comprises positioning at least a portion of the at least one other subassembly within the wellbore during assembling the tension actuator assembly. In an exemplary embodiment, the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support; and wherein coupling the at least one subassembly to the at least one other subassembly comprises coupling the at least one other subassembly to the at least one subassembly. In an exemplary embodiment, the method further comprises preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly. In an exemplary embodiment, the method comprises preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly. In an exemplary embodiment, the first tubular support comprises an internal shoulder; and wherein preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly comprises coupling a retaining ring to the second tubular support; and engaging the retaining ring with the internal shoulder of the first tubular support. In an exemplary embodiment, the method comprises preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support. In an exemplary embodiment, the method comprises decoupling the device from the first tubular support. In an exemplary embodiment, positioning the tension actuator assembly within the wellbore further comprises positioning at least a

portion of the at least one subassembly within the wellbore during assembling the tension actuator assembly.

[000174] A method has been described that includes assembling a tension actuator assembly, comprising coupling at least one subassembly to at least one other subassembly; and positioning the tension actuator assembly within a wellbore; wherein coupling the at least one subassembly to the at least one other subassembly comprises coupling the at least one other subassembly to the at least one subassembly; wherein the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support; wherein the method further comprises preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly wherein the method further comprises preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly; wherein the first tubular support comprises an internal shoulder; wherein preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support; and wherein the method further comprises decoupling the device from the first tubular support.

[000175] A method has been described that includes coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support; preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly, comprising coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support. In an exemplary embodiment, the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, the device comprises first and second bores formed through the body member; and first and second fasteners extending through the first and second bores, respectively, and into the internal recess. In an exemplary embodiment, the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member. In an exemplary

embodiment, the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.

[000176] A method has been described that includes coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support; preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly, comprising coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein the device further comprises first and second bores formed through the body member; and first and second fasteners extending through the first and second bores, respectively, and into the internal recess; wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member; and wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.

[000177] A system has been described that includes means for assembling a tension actuator assembly, comprising means for coupling at least one subassembly to at least one other subassembly; and means for positioning the tension actuator assembly within a wellbore. In an exemplary embodiment, means for positioning the tension actuator assembly within the wellbore comprises means for positioning at least a portion of the at least one other subassembly within the wellbore during assembling the tension actuator assembly. In an exemplary embodiment, the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support; and means for coupling the at least one subassembly to the at least one other subassembly comprises means for coupling the at least one other subassembly to the at least one subassembly. In an exemplary embodiment, the system further comprises means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly. In an exemplary embodiment, the system comprises means for preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly. In an exemplary embodiment, the first tubular support comprises an internal shoulder; and wherein means for preventing the second tubular support

from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly comprises means for coupling a retaining ring to the second tubular support; and means for engaging the retaining ring with the internal shoulder of the first tubular support. In an exemplary embodiment, the system comprises means for preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises means for coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support. In an exemplary embodiment, the system comprises means for decoupling the device from the first tubular support. In an exemplary embodiment, means for positioning the tension actuator assembly within the wellbore further comprises means for positioning at least a portion of the at least one subassembly within the wellbore during assembling the tension actuator assembly.

[000178] A system has been described that includes means for assembling a tension actuator assembly, comprising means for coupling at least one subassembly to at least one other subassembly; and means for positioning the tension actuator assembly within a wellbore; wherein the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support; wherein means for coupling the at least one subassembly to the at least one other subassembly comprises means for coupling the at least one other subassembly to the at least one subassembly; wherein the system further comprises means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly; wherein the system further comprises means for preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly; wherein the first tubular support comprises an internal shoulder; wherein means for preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises means for coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support; and wherein the system further comprises means for decoupling the device from the first tubular support.

[000179] A system has been described that includes means for coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support; means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly, comprising means for coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which

the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support. In an exemplary embodiment, the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, the device further comprises first and second bores formed through the body member; and first and second fasteners extending through the first and second bores, respectively, and into the internal recess. In an exemplary embodiment, the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess. In an exemplary embodiment, the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member. In an exemplary embodiment, the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.

[000180] A system has been described that includes means for coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support; means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly; comprising means for coupling a device to the first tubular support, the device comprising a body member; an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support; wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein the device further comprises first and second bores formed through the body member; and first and second fasteners extending through the first and second bores, respectively, and into the internal recess; wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess; wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member; and wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.

[000181] It is understood that variations may be made in the foregoing without departing from the scope of the invention. For example, the teachings of the present illustrative embodiments may be used to provide a wellbore casing, a pipeline, or a structural support. Furthermore, the elements

and teachings of the various illustrative embodiments may be combined in whole or in part in some or all of the illustrative embodiments. In addition, one or more of the elements and teachings of the various illustrative embodiments may be omitted, at least in part, and/or combined, at least in part, with one or more of the other elements and teachings of the various illustrative embodiments.

[000182] Although illustrative embodiments of the invention have been shown and described, a wide range of modification, changes and substitution is contemplated in the foregoing disclosure. In some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures.

Claims

1. An apparatus comprising:
an actuator assembly comprising:
at least one first tubular support;
at least one second tubular support at least partially extending within the at least one first tubular support, wherein the at least one second tubular support is movable between a first position and a second position; and
at least one adjustable annular region at least partially defined between the at least one first tubular support and the at least one second tubular support and adapted to be pressurized;
wherein the at least one second tubular support is placed in the second position from the first position in response to the pressurization of the at least one adjustable annular region.
2. The apparatus of claim 1 wherein the actuator assembly further comprises:
at least one first sealing element sealingly engaging the outside surface of the at least one second tubular support; and
at least one second sealing element coupled to the at least one second tubular support and sealingly engaging the inside surface of the at least one first tubular support.
3. The apparatus of claim 2 wherein the at least one adjustable annular region is at least partially defined by the at least one second sealing element.
4. The apparatus of claim 3 wherein the at least one second sealing element is movable between a first position and a second position to adjust the size of the at least one adjustable annular region; and
wherein the at least one first sealing element remains stationary during the movement of the at least one second sealing element between the first and second positions.
5. The apparatus of claim 4 wherein each of the at least one first sealing element and the at least one second sealing element comprises a cup.
6. The apparatus of claim 4 wherein a passage is defined by the at least one second tubular support.
7. The apparatus of claim 6 wherein the at least one second tubular support comprises at least one radial opening via which the passage defined by the at least one second tubular support is in fluid communication with the at least one adjustable annular region.
8. The apparatus of claim 1 wherein the actuator assembly further comprises:
one or more torque lugs for transmitting torque through the actuator assembly.
9. The apparatus of claim 1 wherein the actuator assembly further comprises:
one or more first torque lugs for transmitting torque through the actuator assembly when the at least one second tubular support is in the first position; and
one or more second torque lugs for transmitting torque through the actuator assembly when the at least one second tubular support is in the second position.

10. The apparatus of claim 1 further comprising:
an expansion device coupled to the actuator assembly;
wherein the expansion device moves in response to the movement of the at least one second tubular support between the first and second positions.
11. The apparatus of claim 1 further comprising:
a gripping device coupled to the actuator assembly.
12. The apparatus of claim 1 wherein the actuator assembly comprises:
a plurality of first tubular supports, wherein each first tubular support in the plurality of first tubular supports is coupled to at least one other first tubular support in the plurality of first tubular supports; and
a plurality of second tubular supports, wherein each second tubular support in the plurality of second tubular supports at least partially extends within at least one first tubular support in the plurality of first tubular supports.
13. The apparatus of claim 12 wherein the actuator assembly comprises:
a plurality of adjustable annular regions;
wherein each adjustable annular region in the plurality of adjustable annular regions is at least partially defined between one first tubular support in the plurality of first tubular supports and one second tubular support in the plurality of second tubular supports.
14. The apparatus of claim 13 wherein the plurality of adjustable annular regions comprises at least five adjustable annular regions.
15. An apparatus comprising:
an actuator assembly comprising:
at least one first tubular support;
at least one second tubular support at least partially extending within the at least one first tubular support, wherein the at least one second tubular support is movable between a first position and a second position;
at least one first sealing element sealingly engaging the outside surface of the at least one second tubular support;
at least one second sealing element coupled to the at least one second tubular support and sealingly engaging the inside surface of the at least one first tubular support;
at least one adjustable annular region at least partially defined between the at least one first tubular support and the at least one second tubular support and adapted to be pressurized;
wherein the at least one second tubular support is placed in the second position from the first position in response to the pressurization of the at least one adjustable annular region;
wherein the at least one adjustable annular region is at least partially defined by the at least one second sealing element;
wherein the at least one second sealing element is movable between a first position and a

second position to adjust the size of the at least one adjustable annular region;
wherein the at least one first sealing element remains stationary during the movement of the
at least one second sealing element between the first and second positions;
wherein each of the at least one first sealing element and the at least one second sealing
element comprises a cup;
wherein a passage is defined by the at least one second tubular support;
wherein the at least one second tubular support comprises at least one radial opening via
which the passage defined by the at least one second tubular support is in fluid
communication with the at least one adjustable annular region; and
wherein the actuator assembly further comprises:
one or more first torque lugs for transmitting torque through the actuator assembly
when the at least one second tubular support is in the first position; and
one or more second torque lugs for transmitting torque through the actuator assembly
when the at least one second tubular support is in the second position; and
wherein the apparatus further comprises:
an expansion device coupled to the actuator assembly, wherein the expansion device
moves in response to the movement of the at least one second tubular
support between the first and second positions; and
a gripping device coupled to the actuator assembly.

16. A method comprising:
positioning an actuator assembly in a tubular member, the actuator assembly comprising one
or more adjustable annular regions;
placing the actuator assembly in a first configuration; and
placing the actuator assembly in a second configuration, comprising:
pressurizing the one or more adjustable annular regions.
17. The method of claim 16 further comprising:
radially expanding and plastically deforming at least a portion of the tubular member during
placing the actuator assembly in the second configuration.
18. The method of claim 16 further comprising:
coupling the actuator assembly to an expansion device.
19. The method of claim 18 further comprising:
displacing the expansion device to radially expand and plastically deform at least a portion of
the tubular member during placing the actuator assembly in the second configuration.
20. The method of claim 16 wherein pressurizing the one or more adjustable annular regions
comprises:
fluidically pressurizing the one or more adjustable annular regions.
21. The method of claim 16 wherein the actuator assembly comprises:
one or more first tubular supports; and
one or more second tubular supports at least partially extending within the one or more first
tubular supports;

- wherein the one or more adjustable annular regions are at least partially defined between the one or more first tubular supports and the one or more second tubular supports.
22. The method of claim 21 wherein placing the actuator assembly in the second configuration comprises:
displacing the one or more second tubular supports relative to the one or more first tubular supports in response to pressurizing the one or more adjustable annular regions.
23. The method of claim 22 wherein pressurizing the one or more adjustable annular regions comprises:
fluidically pressurizing the one or more adjustable annular regions.
24. The method of claim 23 wherein fluidically pressurizing the one or more adjustable annular regions comprises:
introducing fluidic material into one or more passages defined by the one or more second tubular supports; and
permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions.
25. The method of claim 24 wherein fluidically pressurizing the one or more adjustable annular regions further comprises:
sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements; and
sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements.
26. The method of claim 25 wherein each of the one or more first sealing elements and the one or second sealing elements comprises a cup.
27. The method of claim 23 wherein the actuator assembly comprises at least five adjustable annular regions.
28. The method of claim 16 further comprising:
transmitting torque through the actuator assembly.
29. The method of claim 16 further comprising:
transmitting torque through the actuator assembly in the first configuration.
30. The method of claim 16 further comprising:
transmitting torque through the actuator assembly in the second configuration.
31. The method of claim 16 further comprising:
transmitting torque through the actuator assembly in the first configuration; and
transmitting torque through the actuator assembly in the second configuration.
32. The method of claim 16 further comprising:
coupling a gripping device to the actuator assembly.
33. The method of claim 32 wherein placing the actuator assembly in the second configuration comprises:
gripping the tubular member using the gripping device.
34. A method comprising:

positioning an actuator assembly in a tubular member, the actuator assembly comprising:
one or more first tubular supports;
one or more second tubular supports at least partially extending within the one or more first tubular supports; and
one or more adjustable annular regions at least partially defined between the one or more first tubular supports and the one or more second tubular supports;
placing the actuator assembly in a first configuration; and
placing the actuator assembly in a second configuration, comprising:
fluidically pressurizing the one or more adjustable annular regions, comprising:
sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements;
sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements;
introducing fluidic material into one or more passages defined by the one or more second tubular supports; and
permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions;
and
displacing the one or more second tubular supports relative to the one or more first tubular supports in response to fluidically pressurizing the one or more adjustable annular regions;
coupling the actuator assembly to an expansion device;
radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration, comprising:
displacing the expansion device to radially expand and plastically deform the at least a portion of the tubular member during placing the actuator assembly in the second configuration;
permitting torque to be transmitted through the actuator assembly in the first configuration;
permitting torque to be transmitted through the actuator assembly in the second configuration;
and
coupling a gripping device to the actuator assembly;
wherein placing the actuator assembly in the second configuration comprises:
gripping the tubular member using the gripping device.

35. A system comprising:
means for positioning an actuator assembly in a tubular member, the actuator assembly comprising one or more adjustable annular regions;
means for placing the actuator assembly in a first configuration; and
means for placing the actuator assembly in a second configuration, comprising:
means for pressurizing the one or more adjustable annular regions.
36. The system of claim 35 further comprising:

- means for radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration.
37. The system of claim 35 further comprising:
means for coupling the actuator assembly to an expansion device.
38. The system of claim 37 further comprising:
means for displacing the expansion device to radially expand and plastically deform at least a portion of the tubular member during placing the actuator assembly in the second configuration.
39. The system of claim 35 wherein means for pressurizing the one or more adjustable annular regions comprises:
means for fluidically pressurizing the one or more adjustable annular regions.
40. The system of claim 35 wherein the actuator assembly comprises:
one or more first tubular supports; and
one or more second tubular supports at least partially extending within the one or more first tubular supports;
wherein the one or more adjustable annular regions are at least partially defined between the one or more first tubular supports and the one or more second tubular supports.
41. The system of claim 40 wherein means for placing the actuator assembly in the second configuration comprises:
means for displacing the one or more second tubular supports relative to the one or more first tubular supports in response to pressurizing the one or more adjustable annular regions.
42. The system of claim 41 wherein means for pressurizing the one or more adjustable annular regions comprises:
fluidically pressurizing the one or more adjustable annular regions.
43. The system of claim 42 wherein means for fluidically pressurizing the one or more adjustable annular regions comprises:
means for introducing fluidic material into one or more passages defined by the one or more second tubular supports; and
means for permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions.
44. The system of claim 43 wherein means for fluidically pressurizing the one or more adjustable annular regions further comprises:
means for sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements; and
means for sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements.
45. The system of claim 44 wherein each of the one or more first sealing elements and the one or more second sealing elements comprises a cup.
46. The system of claim 43 wherein the actuator assembly comprises at least five adjustable

annular regions.

47. The system of claim 35 further comprising:
means for transmitting torque through the actuator assembly.
48. The system of claim 35 further comprising:
means for transmitting torque through the actuator assembly in the first configuration.
49. The system of claim 35 further comprising:
means for transmitting torque through the actuator assembly in the second configuration.
50. The system of claim 35 further comprising:
transmitting torque through the actuator assembly in the first configuration; and
transmitting torque through the actuator assembly in the second configuration.
51. The system of claim 35 further comprising:
means for coupling a gripping device to the actuator assembly.
52. The system of claim 51 wherein means for placing the actuator assembly in the second configuration comprises:
means for gripping the tubular member using the gripping device.
53. A system comprising:
means for positioning an actuator assembly in a tubular member, the actuator assembly comprising:
one or more first tubular supports;
one or more second tubular supports at least partially extending within the one or more first tubular supports; and
one or more adjustable annular regions at least partially defined between the one or more first tubular supports and the one or more second tubular supports;
means for placing the actuator assembly in a first configuration; and
means for placing the actuator assembly in a second configuration, comprising:
means for fluidically pressurizing the one or more adjustable annular regions,
comprising:
means for sealingly engaging an outside surface of each of the one or more second tubular supports with one or more first sealing elements;
means for sealingly engaging an inside surface of each of the one or more first tubular supports with one or more second sealing elements;
means for introducing fluidic material into one or more passages defined by the one or more second tubular supports; and
means for permitting the fluidic material to flow from the one or more passages and into the one or more adjustable annular regions;
and
means for displacing the one or more second tubular supports relative to the one or more first tubular supports in response to fluidically pressurizing the one or more adjustable annular regions;
means for coupling the actuator assembly to an expansion device;

means for radially expanding and plastically deforming at least a portion of the tubular member during placing the actuator assembly in the second configuration, comprising:

means for displacing the expansion device to radially expand and plastically deform the at least a portion of the tubular member during placing the actuator assembly in the second configuration;

means for permitting torque to be transmitted through the actuator assembly in the first configuration;

means for permitting torque to be transmitted through the actuator assembly in the second configuration; and

means for coupling a gripping device to the actuator assembly;

wherein means for placing the actuator assembly in the second configuration comprises:

means for gripping the tubular member using the gripping device.

54. A method comprising:
assembling a tension actuator assembly, comprising:
coupling at least one subassembly to at least one other subassembly; and
positioning the tension actuator assembly within a wellbore.
55. The method of claim 54 wherein positioning the tension actuator assembly within the wellbore comprises:
positioning at least a portion of the at least one other subassembly within the wellbore during assembling the tension actuator assembly.
56. The method of claim 54 wherein the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support.
57. The method of claim 56 wherein the method further comprises:
preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly.
58. The method of claim 57 further comprising:
preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly.
59. The method of claim 58 wherein the first tubular support comprises an internal shoulder; and wherein preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly comprises:
coupling a retaining ring to the second tubular support; and
engaging the retaining ring with the internal shoulder of the first tubular support.
60. The method of claim 57 wherein preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly

to the at least one other subassembly comprises:

coupling a device to the first tubular support, the device comprising:

a body member;

an opening in the body member within which the second tubular support at least

partially extends after the device is coupled to the first tubular support; and

an internal recess in the body member within which the first tubular support at least

partially extends after the device is coupled to the first tubular support.

61. The method of claim 60 further comprising:

decoupling the device from the first tubular support.

62. The method of claim 54 wherein positioning the tension actuator assembly within the wellbore further comprises:

positioning at least a portion of the at least one subassembly within the wellbore during

assembling the tension actuator assembly.

63. A method comprising:

assembling a tension actuator assembly, comprising:

coupling at least one subassembly to at least one other subassembly; and

positioning the tension actuator assembly within a wellbore;

wherein the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support;

wherein the method further comprises:

preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly.

wherein the method further comprises:

preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly;

wherein the first tubular support comprises an internal shoulder;

wherein preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises:

coupling a device to the first tubular support, the device comprising:

a body member;

an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and

an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support; and

wherein the method further comprises:

- decoupling the device from the first tubular support.
64. A system comprising:
means for assembling a tension actuator assembly, comprising:
means for coupling at least one subassembly to at least one other subassembly;
and
means for positioning the tension actuator assembly within a wellbore.
65. The system of claim 64 wherein means for positioning the tension actuator assembly within the wellbore comprises:
means for positioning at least a portion of the at least one other subassembly within the wellbore during assembling the tension actuator assembly.
66. The system of claim 65 wherein the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support.
67. The system of claim 66 wherein the system further comprises:
means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly.
68. The system of claim 67 further comprising:
means for preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly.
69. The system of claim 68 wherein the first tubular support comprises an internal shoulder; and wherein means for preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly comprises:
means for coupling a retaining ring to the second tubular support; and
means for engaging the retaining ring with the internal shoulder of the first tubular support.
70. The system of claim 67 wherein means for preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises:
means for coupling a device to the first tubular support, the device comprising:
a body member;
an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and
an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support.
71. The system of claim 70 further comprising:
means for decoupling the device from the first tubular support.

72. The system of claim 71 wherein means for positioning the tension actuator assembly within the wellbore further comprises:
means for positioning at least a portion of the at least one subassembly within the wellbore during assembling the tension actuator assembly.
73. A system comprising:
means for assembling a tension actuator assembly, comprising:
means for coupling at least one subassembly to at least one other subassembly;
and
means for positioning the tension actuator assembly within a wellbore;
wherein the at least one subassembly comprises a first tubular support and a second tubular support at least partially positioned within the first tubular support;
wherein the system further comprises:
means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly; and
means for preventing the second tubular support from moving in the axial direction relative to the first tubular support during coupling the at least one subassembly to the at least one other subassembly;
wherein the first tubular support comprises an internal shoulder;
wherein means for preventing the first tubular support from moving in the axial direction relative to the second tubular support during coupling the at least one subassembly to the at least one other subassembly comprises:
means for coupling a device to the first tubular support, the device comprising:
a body member;
an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and
an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support; and
wherein the system further comprises:
means for decoupling the device from the first tubular support.
74. A device adapted to be coupled to a first tubular support within which a second tubular support at least partially extends, the device comprising:
a body member;
an opening in the body member within which the second tubular support is adapted to at least partially extend when the device is coupled to the first tubular support; and
an internal recess in the body member within which the first tubular support is adapted to at least partially extend when the device is coupled to the first tubular support.
75. The device of claim 74 wherein the internal recess defines an internal shoulder with which the

- first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess.
76. The device of claim 75 wherein movement of the first tubular support, in an axial direction and relative to the second tubular support, is generally prevented when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess.
77. The device of claim 76 wherein the body member defines an end surface with which at least a portion of the second tubular support is adjacent when the second tubular support at least partially extends within the opening.
78. The device of claim 77 wherein movement of the second tubular support, in another axial direction and relative to the first tubular support, is generally prevented when the device is coupled to the first tubular support, the first tubular support at least partially extends within the internal recess and the second tubular support at least partially extends within the opening.
79. The device of claim 78 further comprising:
first and second bores formed through the body member; and
first and second fasteners extending through the first and second bores, respectively, and into the internal recess.
80. The device of claim 79 wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess.
81. The device of claim 80 wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member.
82. The device of claim 81 wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.
83. The device of claim 82 further comprising:
one or more handles connected to the body member.
84. A device adapted to be coupled to a first tubular support within which a second tubular support at least partially extends, the device comprising:
a body member;
an opening in the body member within which the second tubular support is adapted to at least partially extend when the device is coupled to the first tubular support; and
an internal recess in the body member within which the first tubular support is adapted to at least partially extend when the device is coupled to the first tubular support;
wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess;

- wherein movement of the first tubular support, in an axial direction and relative to the second tubular support, is generally prevented when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess;
- wherein the body member defines an end surface with which at least a portion of the second tubular support is adjacent when the second tubular support at least partially extends within the opening;
- wherein the device further comprises:
- first and second bores formed through the body member;
 - first and second fasteners extending through the first and second bores, respectively, and into the internal recess; and
 - one or more handles connected to the body member;
- wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess;
- wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member; and
- wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.
85. A method comprising:
- coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support;
 - preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly, comprising:
 - coupling a device to the first tubular support, the device comprising:
 - a body member;
 - an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and
 - an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support.
86. The method of claim 85 wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess.

87. The method of claim 86 wherein the device further comprises:
first and second bores formed through the body member; and
first and second fasteners extending through the first and second bores, respectively, and into
the internal recess.
88. The method of claim 87 wherein the first and second fasteners are adapted to further extend
into first and second radial openings, respectively, in the first tubular support when the device
is coupled to the first tubular support and the first tubular support at least partially extends
within the internal recess.
89. The method of claim 88 wherein the opening defines a first internal arcuate surface of the
body member and first and second parallel-spaced surfaces of the body member extending
from the first internal arcuate surface of the body member.
90. The method of claim 89 wherein the internal recess defines a second internal arcuate surface
of the body member and third and fourth parallel-spaced surfaces of the body member
extending from the second internal arcuate surface of the body member.
91. A method comprising:
coupling a first subassembly to a second subassembly, the first subassembly comprising a
first tubular support and a second tubular support at least partially positioned within
the first tubular support;
preventing the first tubular support from moving in an axial direction relative to the second
tubular support during coupling the first subassembly to the second subassembly,
comprising:
coupling a device to the first tubular support, the device comprising:
a body member;
an opening in the body member within which the second tubular
support at least partially extends after the device is coupled
to the first tubular support; and
an internal recess in the body member within which the first tubular
support at least partially extends after the device is coupled
to the first tubular support.
wherein the internal recess defines an internal shoulder with which the first tubular support is
adjacent when the device is coupled to the first tubular support and the first tubular
support at least partially extends within the internal recess;
wherein the device further comprises:
first and second bores formed through the body member; and
first and second fasteners extending through the first and second bores, respectively,
and into the internal recess;
wherein the first and second fasteners are adapted to further extend into first and second
radial openings, respectively, in the first tubular support when the device is coupled to
the first tubular support and the first tubular support at least partially extends within
the internal recess;

- wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member; and
- wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.
92. A system comprising:
- means for coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support;
- means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly, comprising:
- means for coupling a device to the first tubular support, the device comprising:
- a body member;
- an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and
- an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support.
93. The system of claim 92 wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess.
94. The system of claim 93 wherein the device further comprises:
- first and second bores formed through the body member; and
- first and second fasteners extending through the first and second bores, respectively, and into the internal recess.
95. The system of claim 94 wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess.
96. The system of claim 95 wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member.
97. The system of claim 96 wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.
98. A system comprising:

means for coupling a first subassembly to a second subassembly, the first subassembly comprising a first tubular support and a second tubular support at least partially positioned within the first tubular support;

means for preventing the first tubular support from moving in an axial direction relative to the second tubular support during coupling the first subassembly to the second subassembly, comprising:

means for coupling a device to the first tubular support, the device comprising:

a body member;

an opening in the body member within which the second tubular support at least partially extends after the device is coupled to the first tubular support; and

an internal recess in the body member within which the first tubular support at least partially extends after the device is coupled to the first tubular support.

wherein the internal recess defines an internal shoulder with which the first tubular support is adjacent when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess;

wherein the device further comprises:

first and second bores formed through the body member; and

first and second fasteners extending through the first and second bores, respectively, and into the internal recess;

wherein the first and second fasteners are adapted to further extend into first and second radial openings, respectively, in the first tubular support when the device is coupled to the first tubular support and the first tubular support at least partially extends within the internal recess;

wherein the opening defines a first internal arcuate surface of the body member and first and second parallel-spaced surfaces of the body member extending from the first internal arcuate surface of the body member; and

wherein the internal recess defines a second internal arcuate surface of the body member and third and fourth parallel-spaced surfaces of the body member extending from the second internal arcuate surface of the body member.

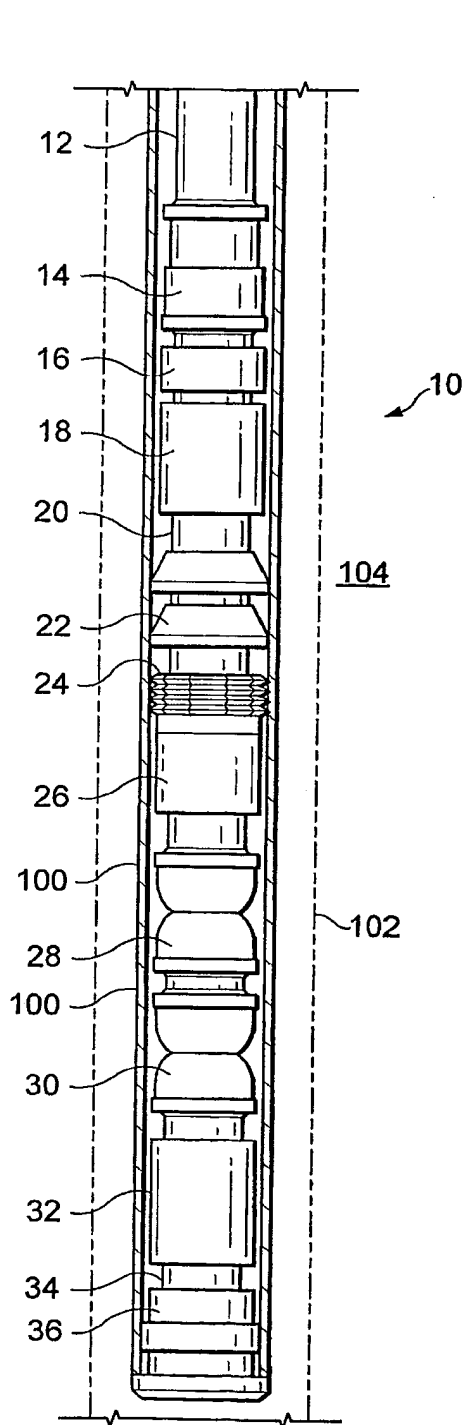


Fig. 1

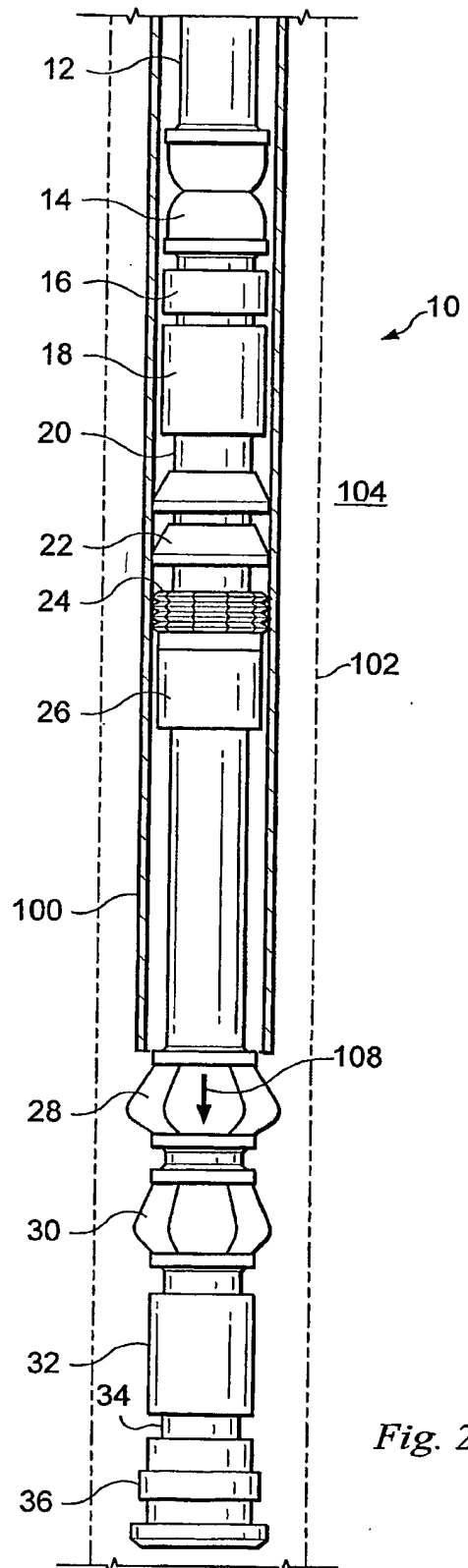
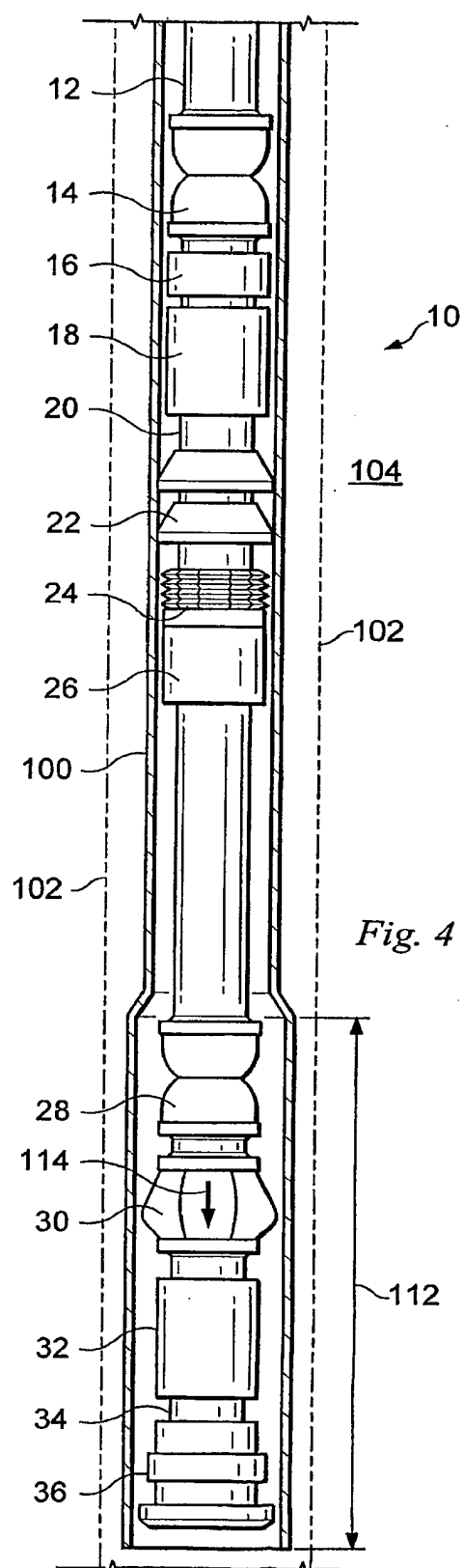
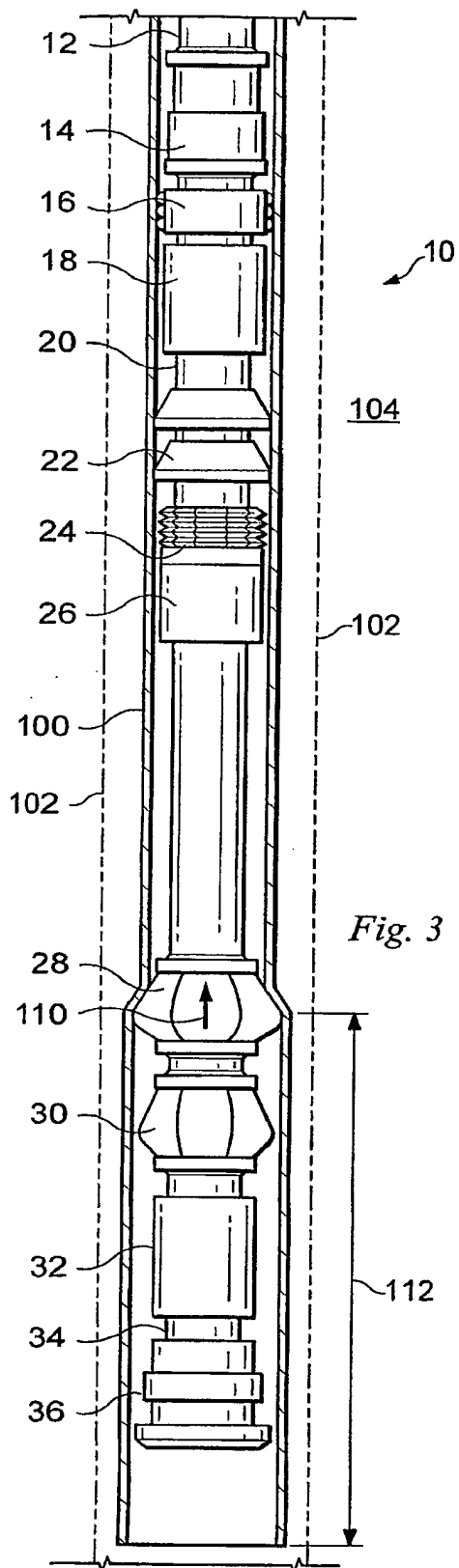


Fig. 2



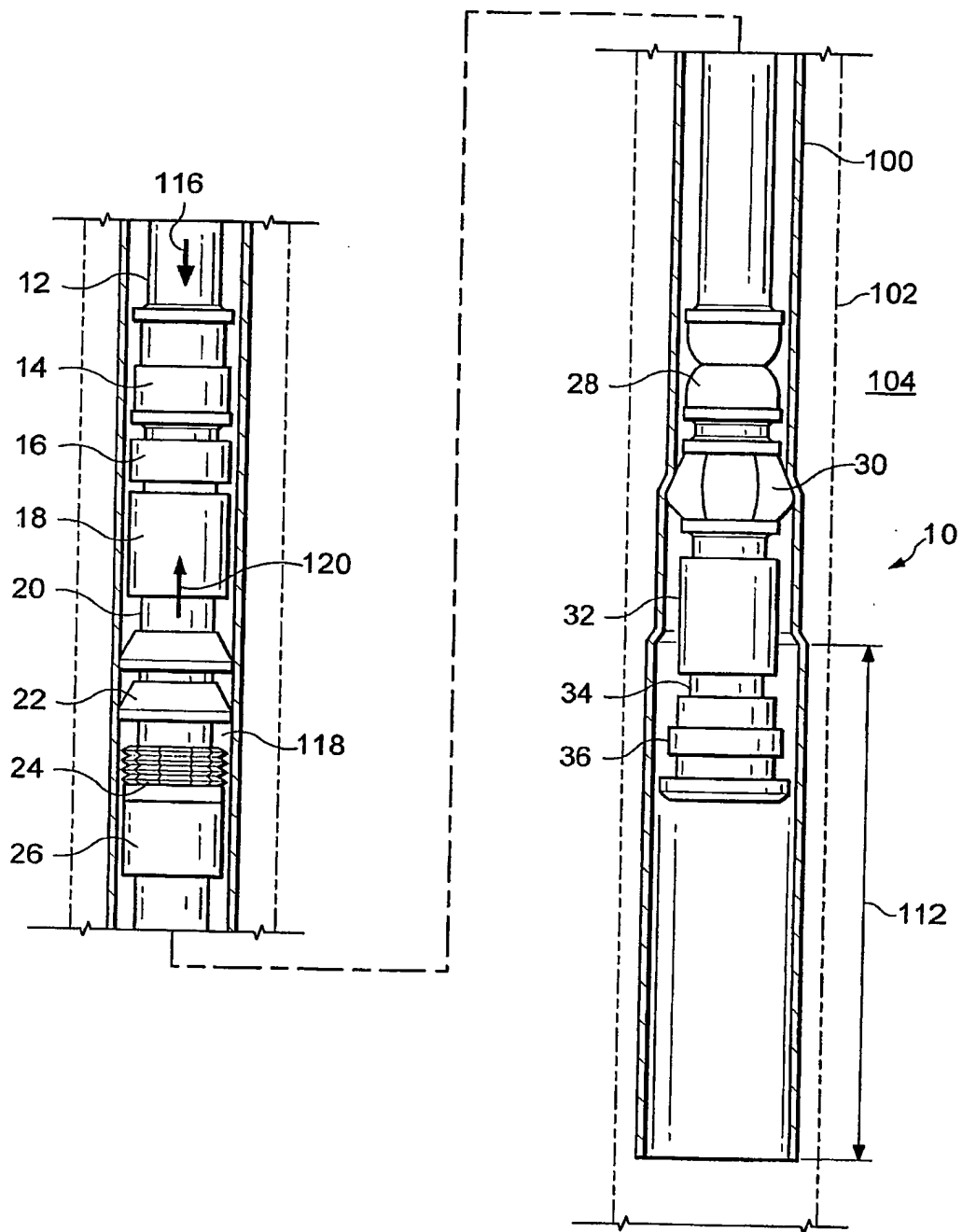


Fig. 5

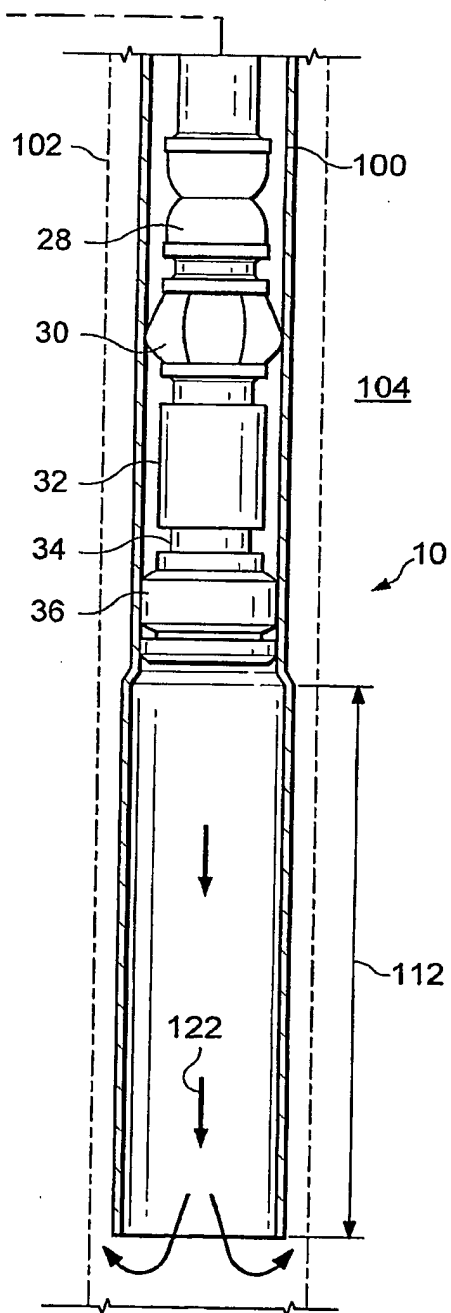
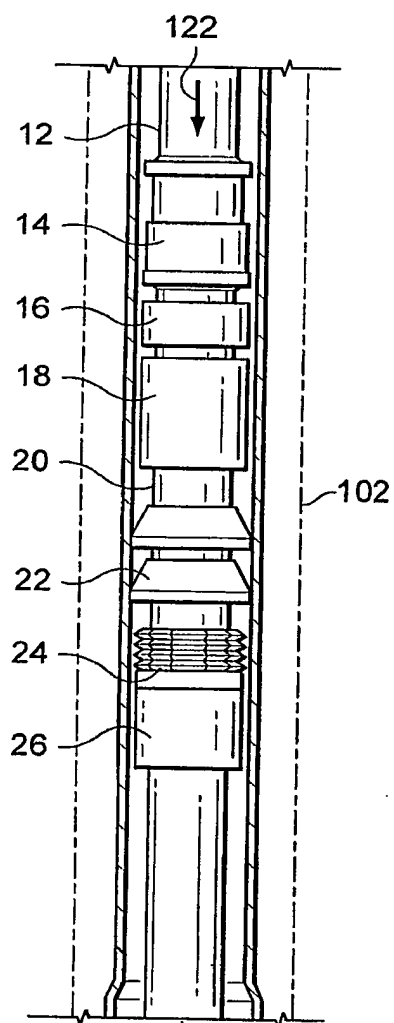


Fig. 6

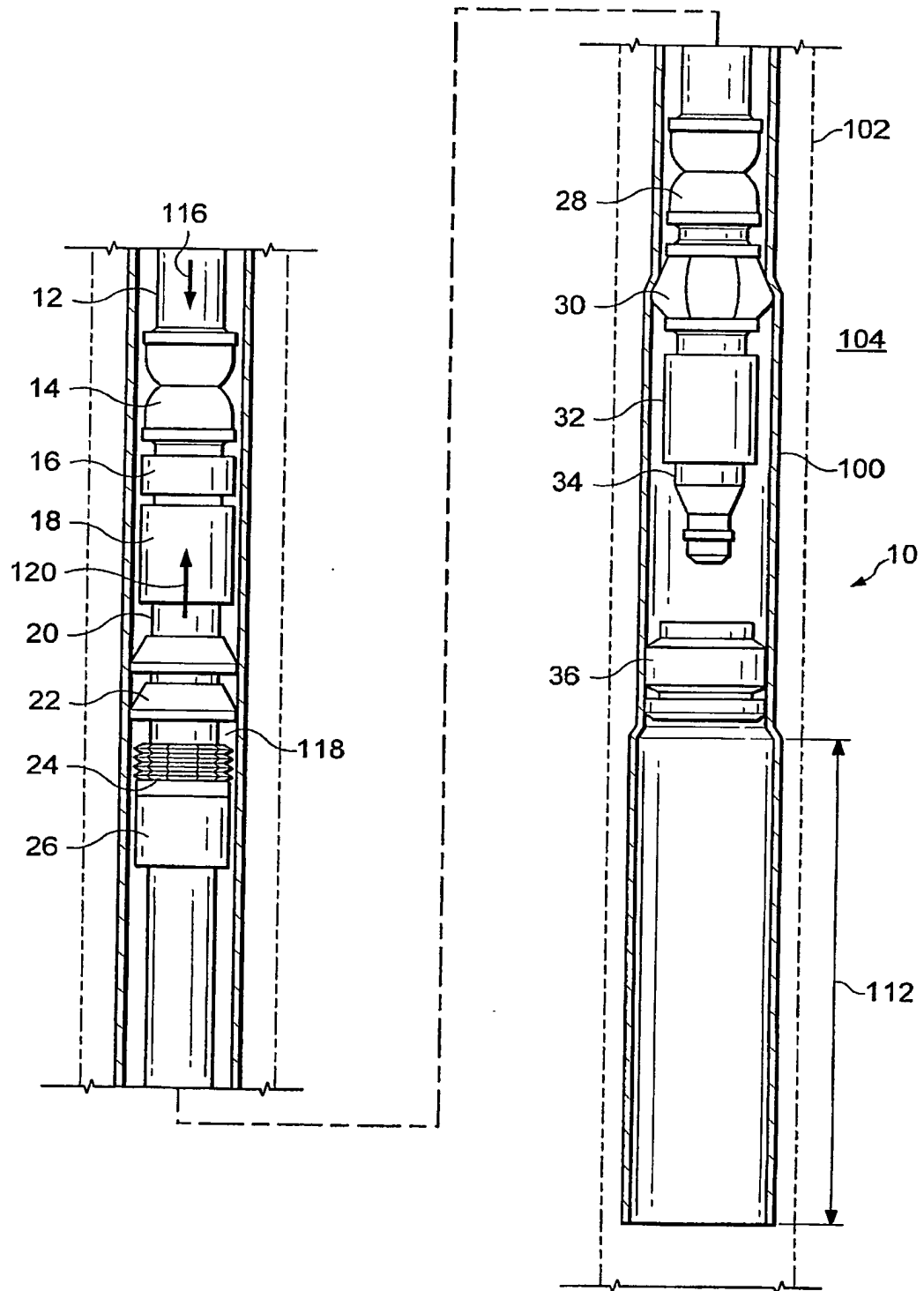


Fig. 7

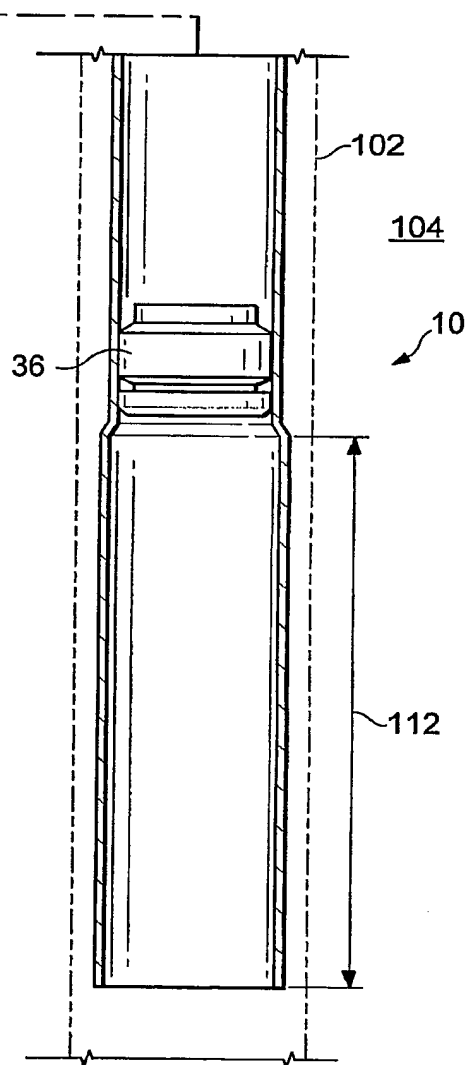
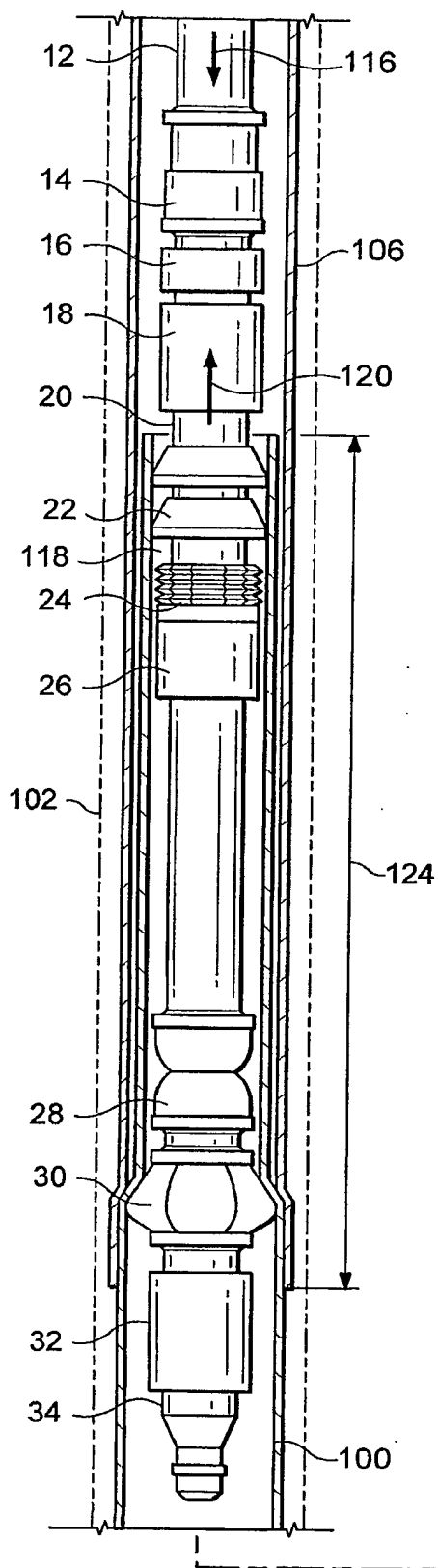


Fig. 8

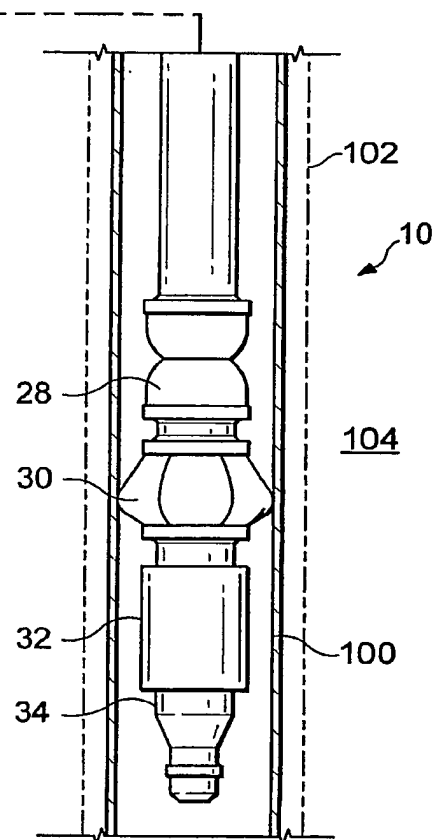
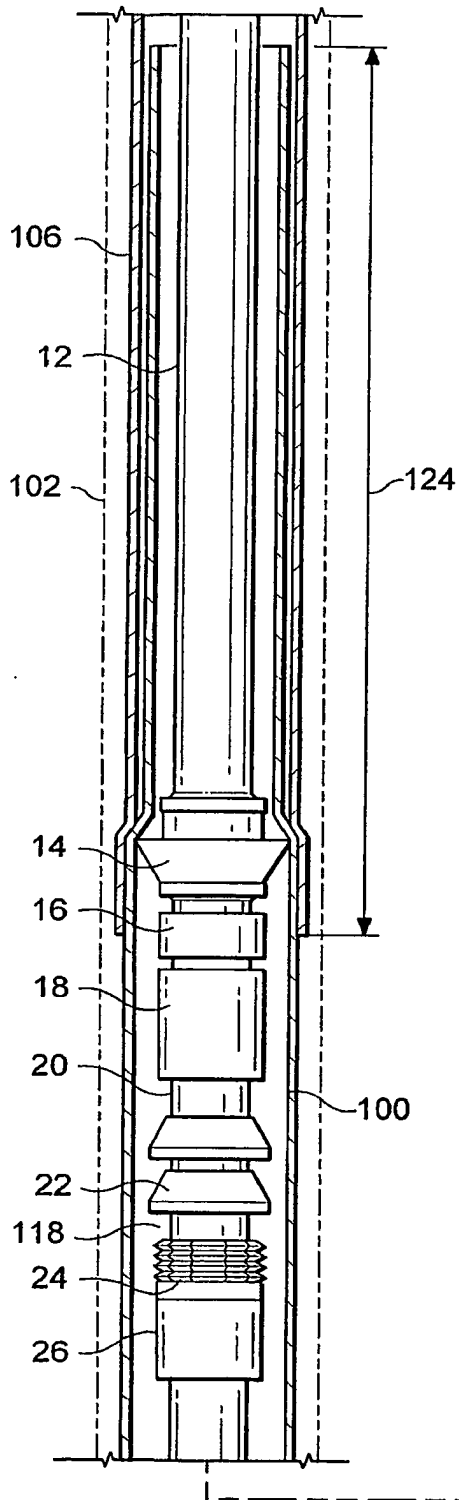


Fig. 9

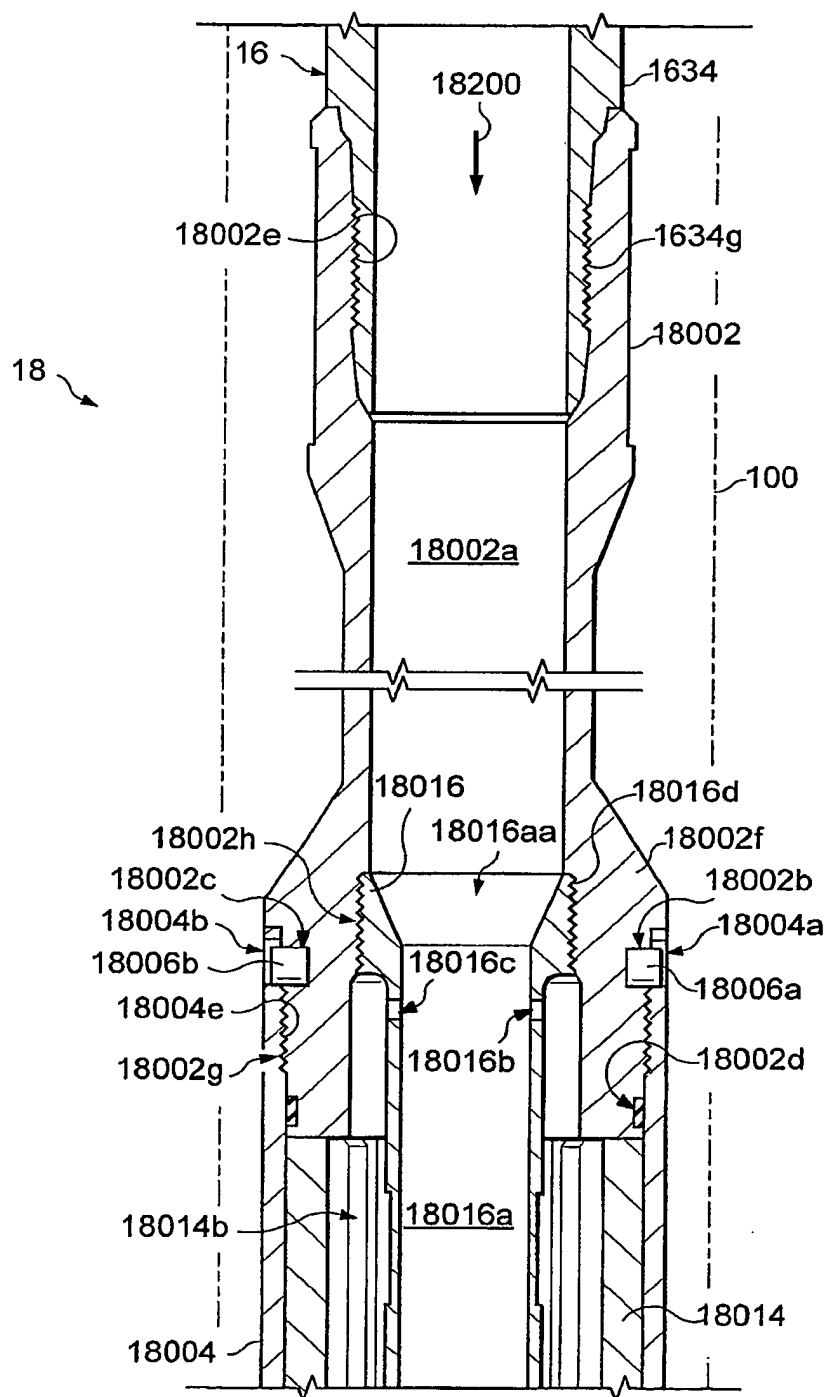
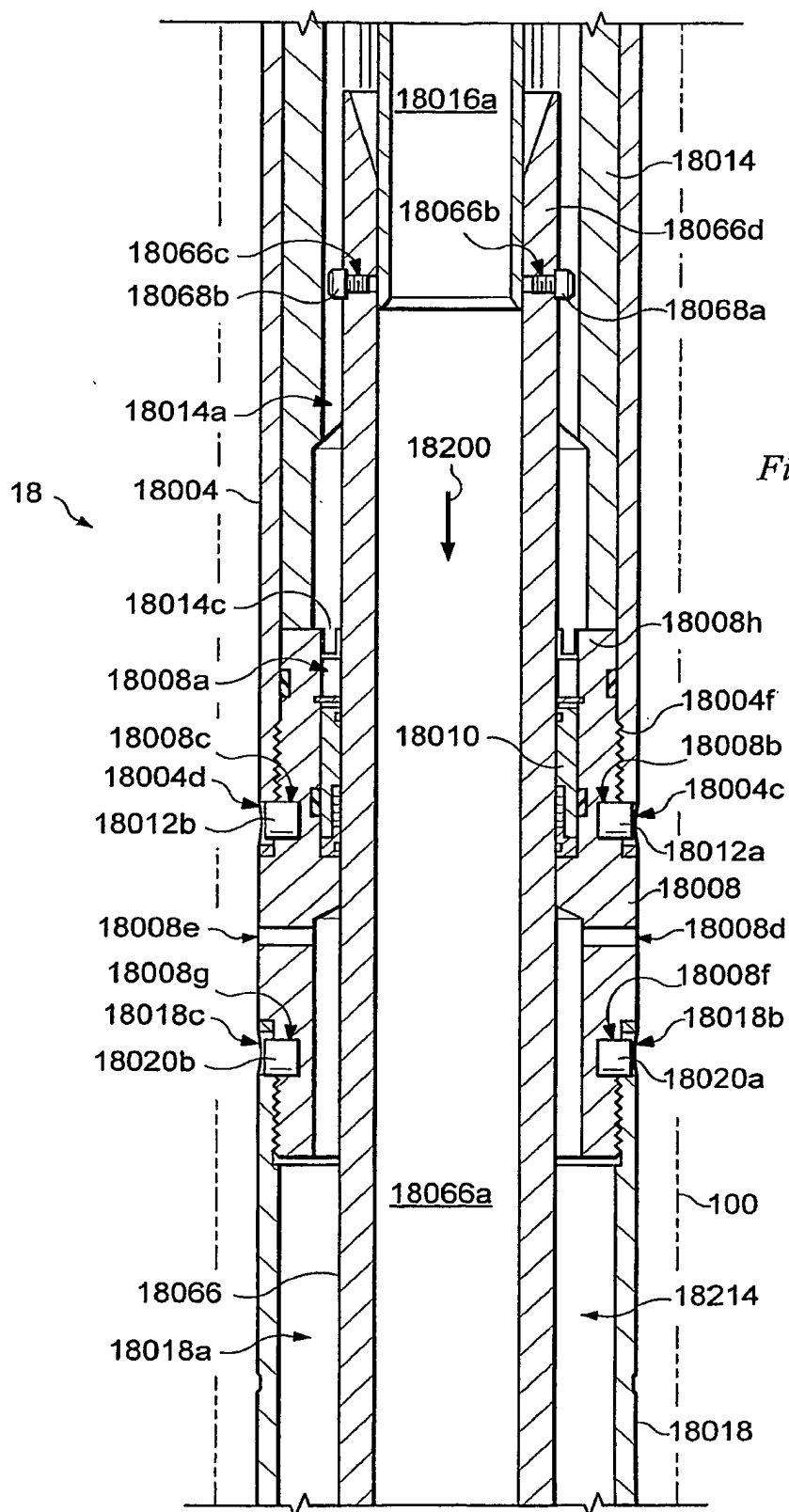


Fig. 13A1



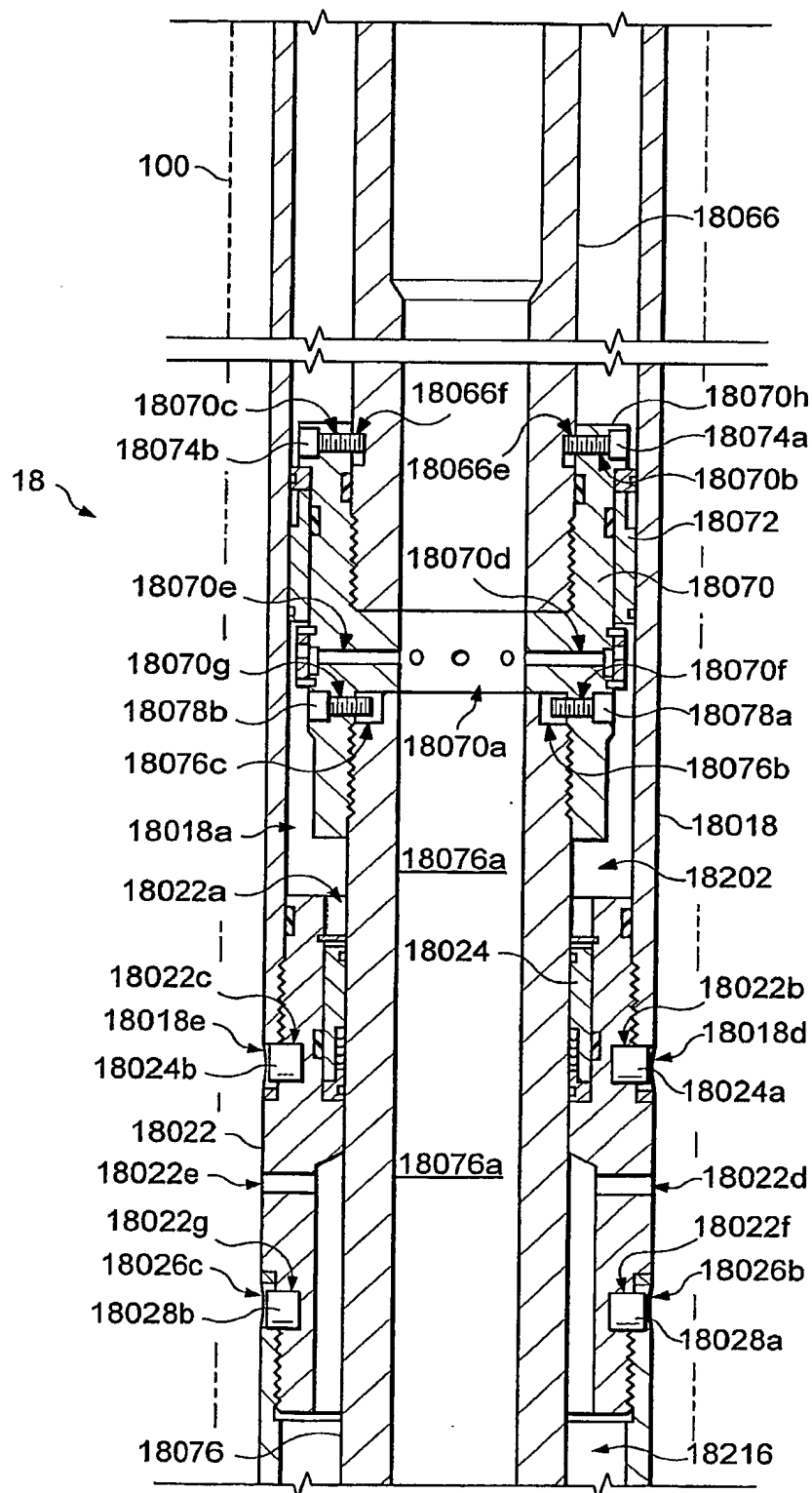
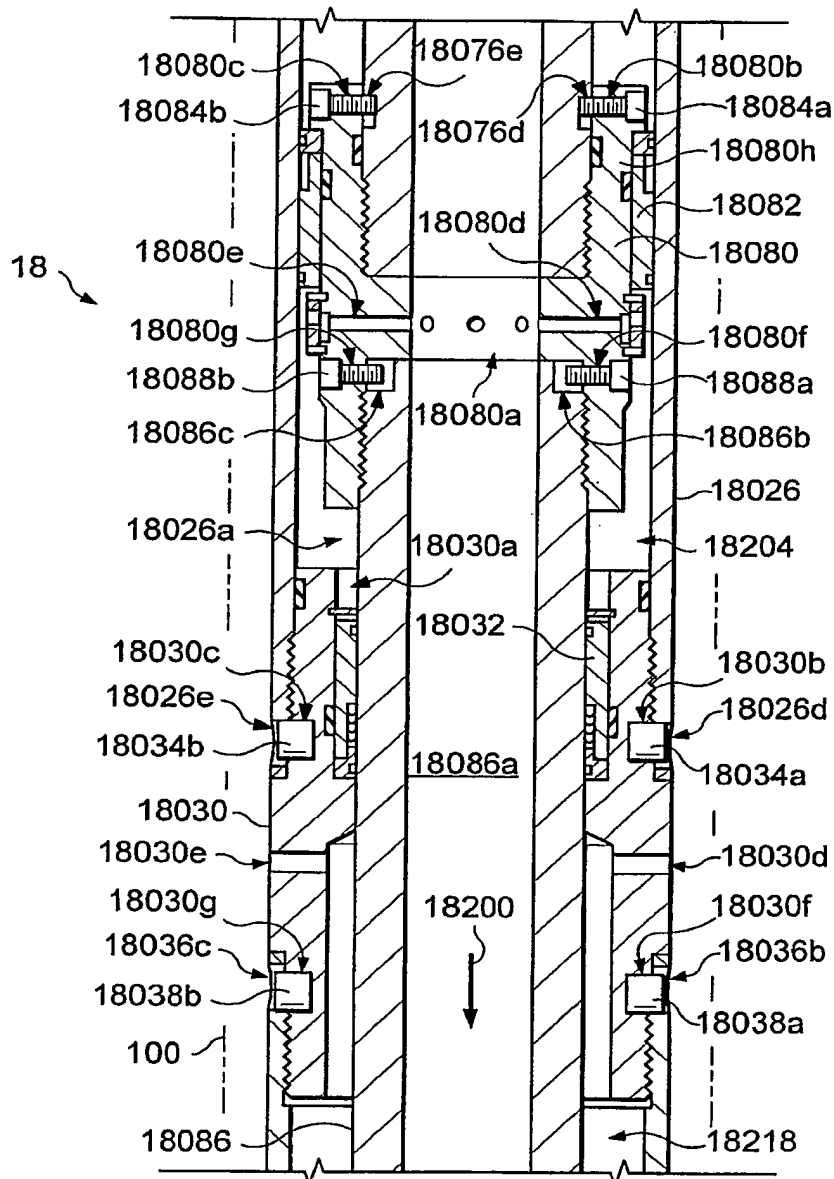


Fig. 13A3

*Fig. 13A4*

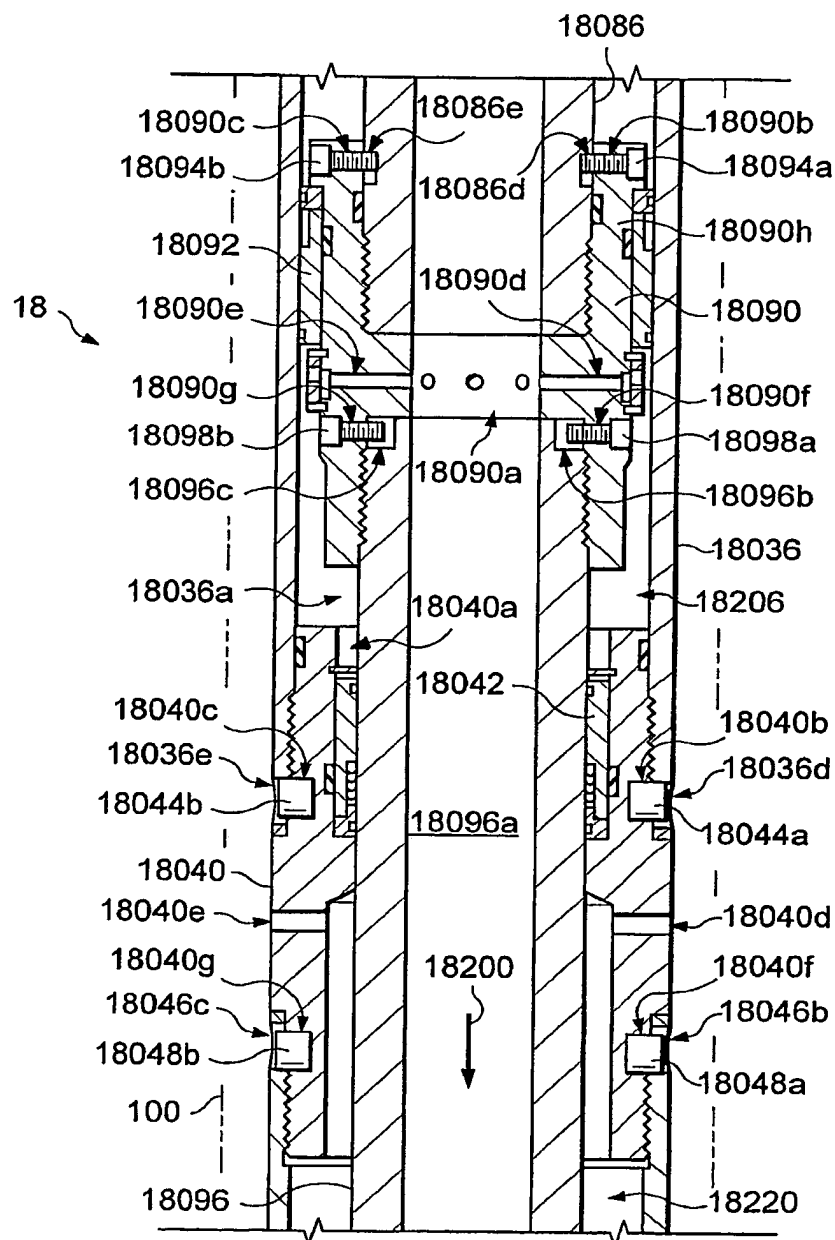
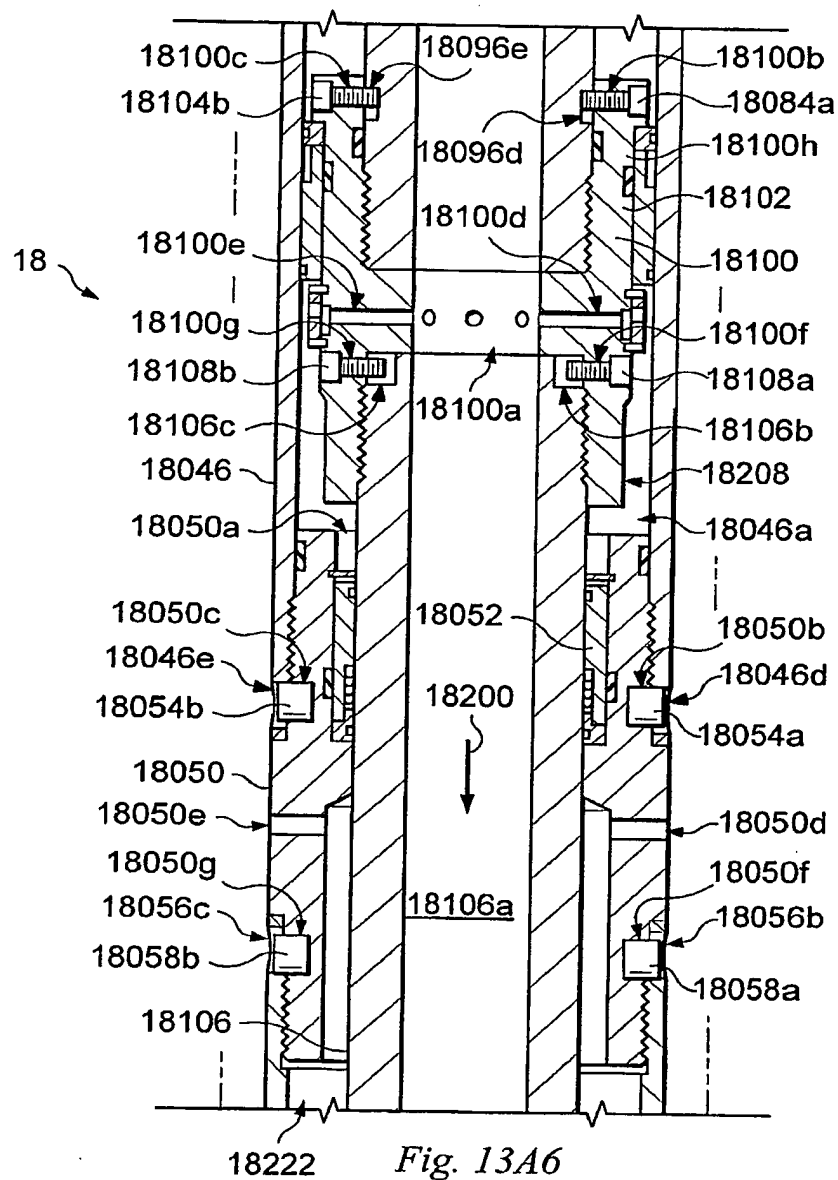


Fig. 13A5



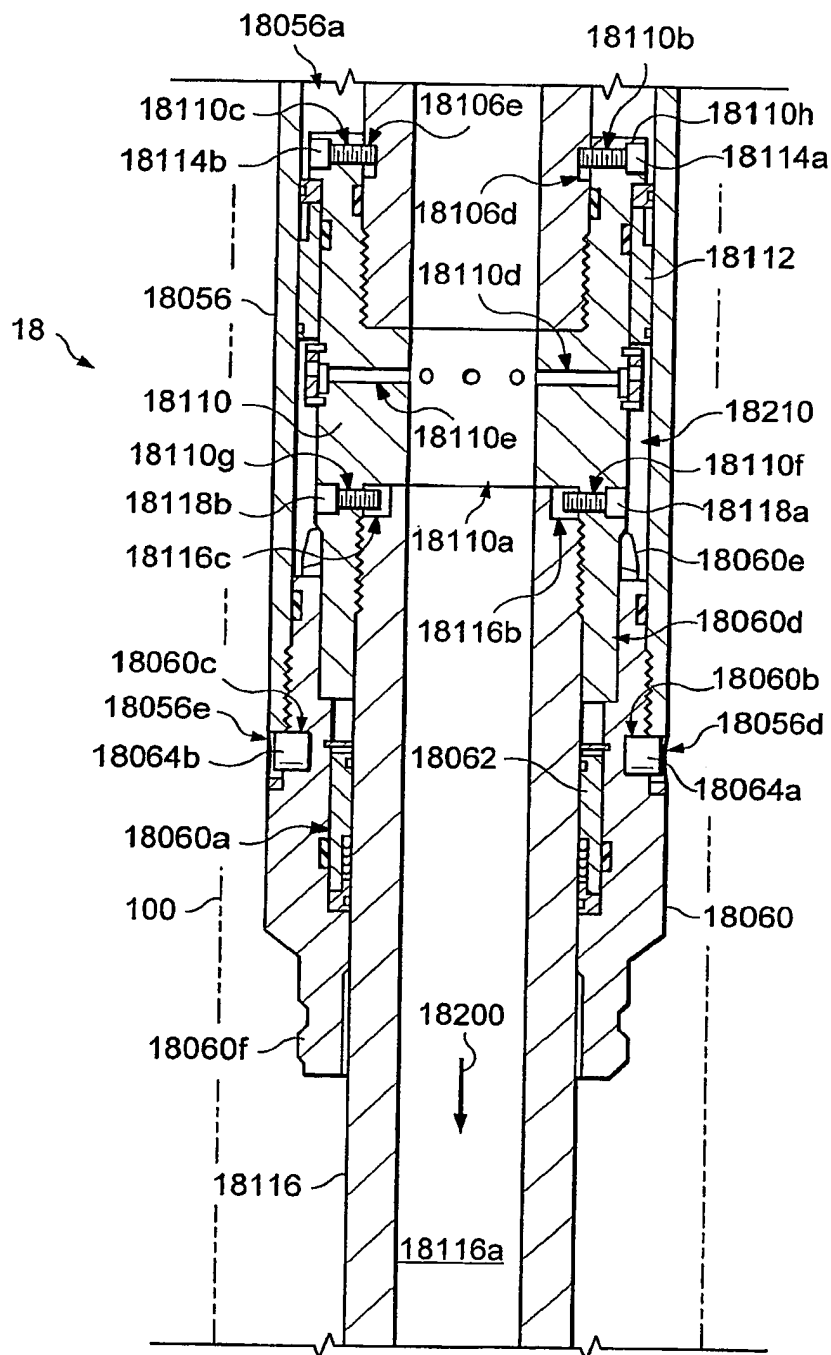
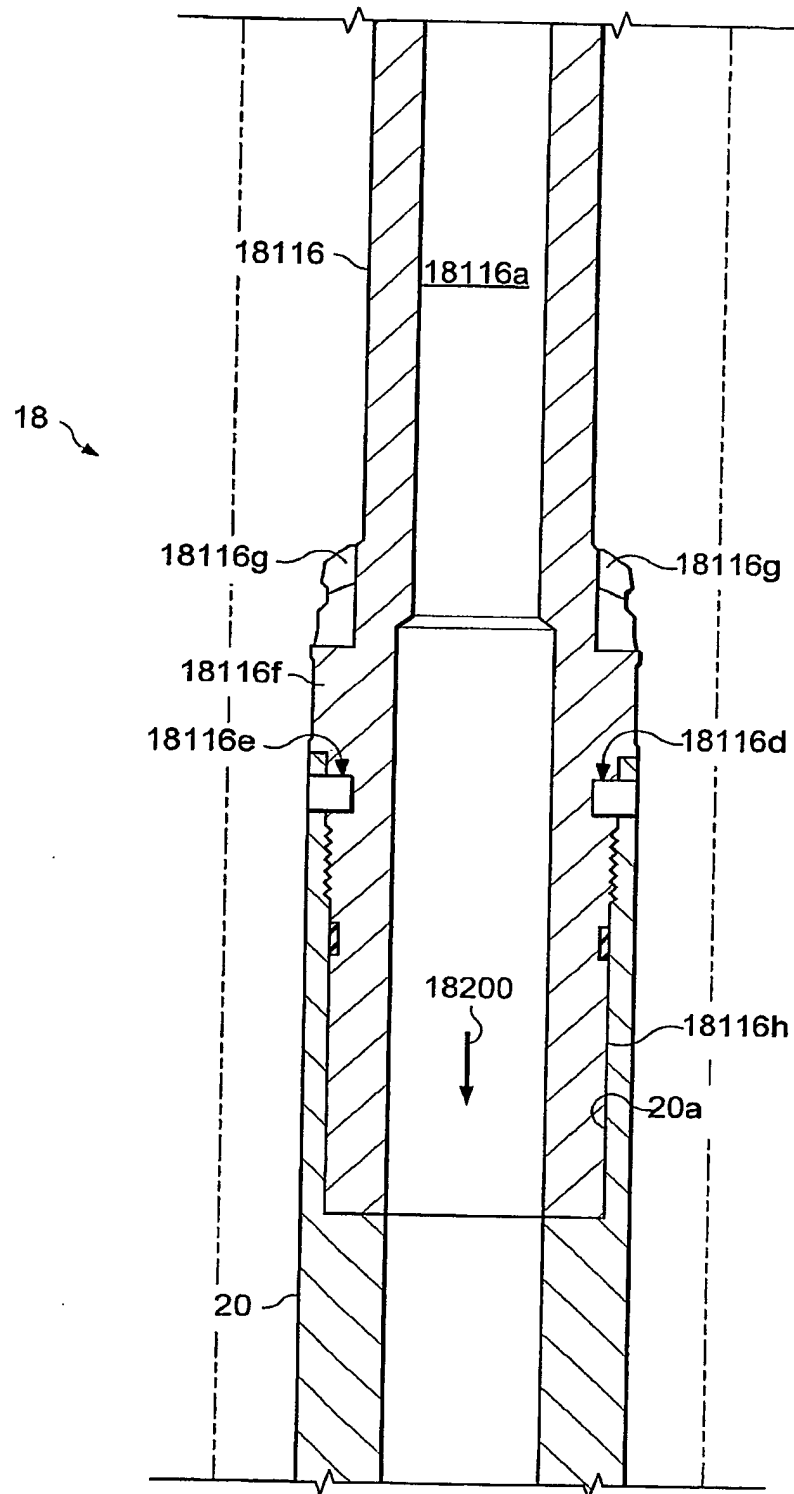


Fig. 13A7

*Fig. 13A8*

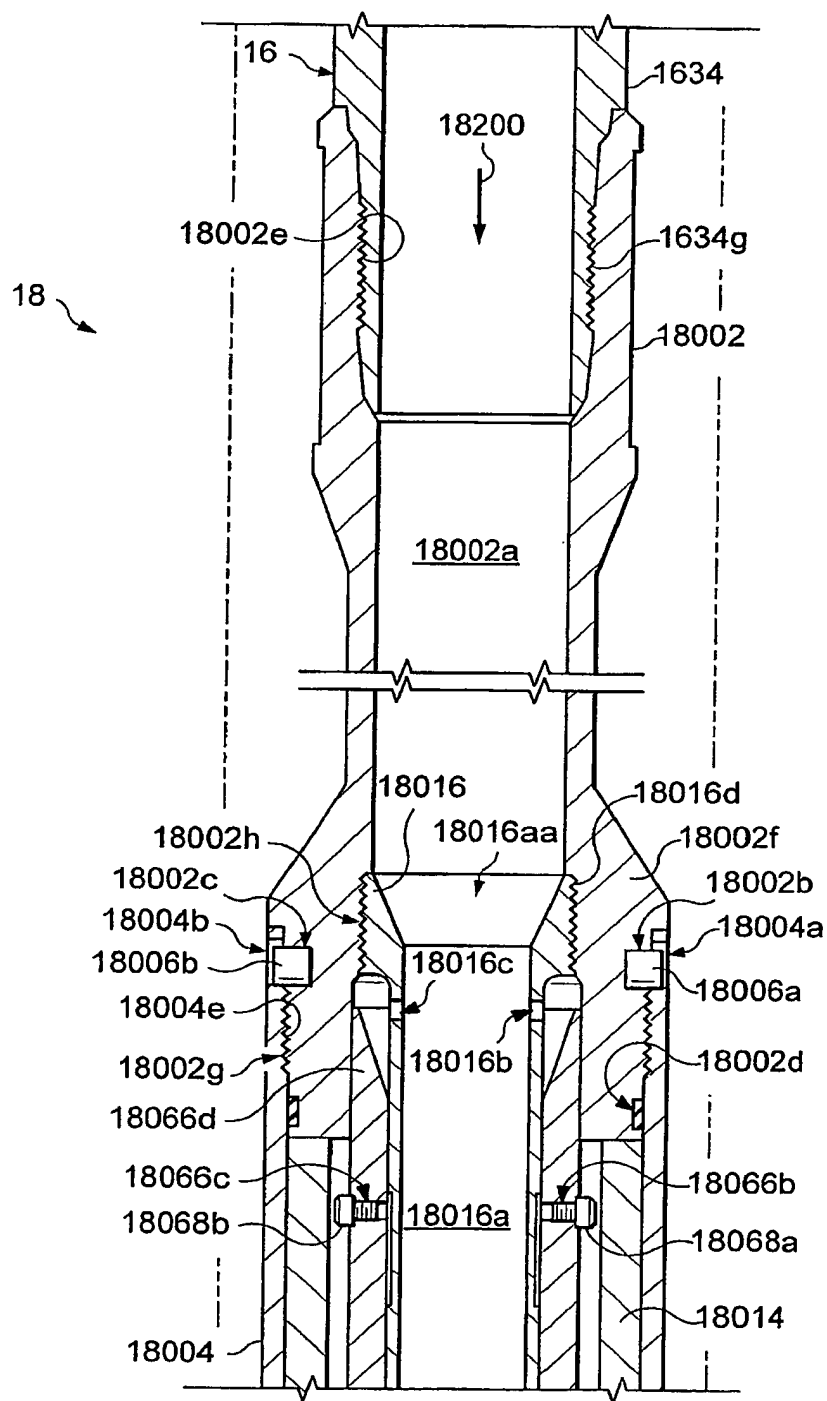
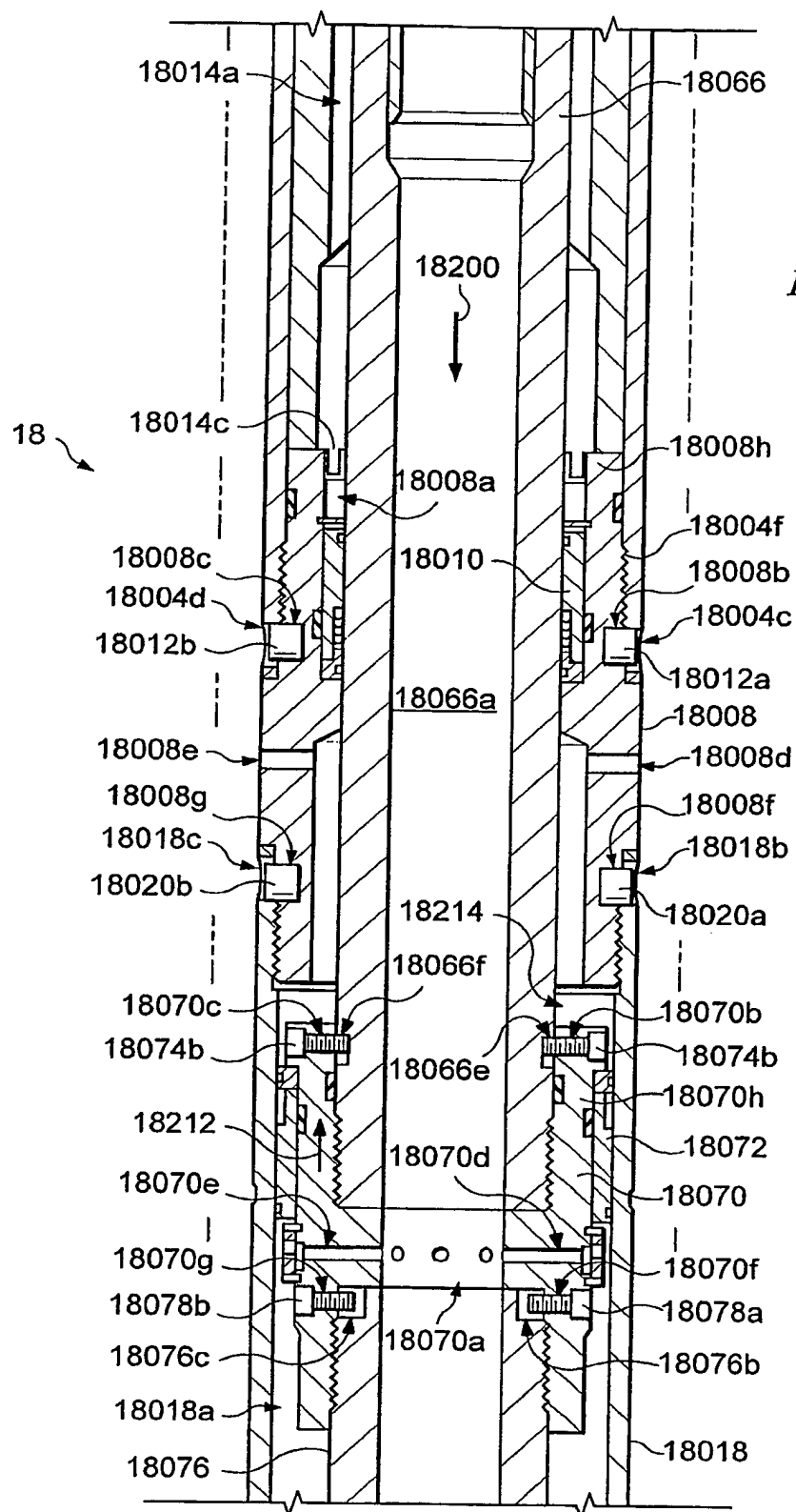


Fig. 13B1



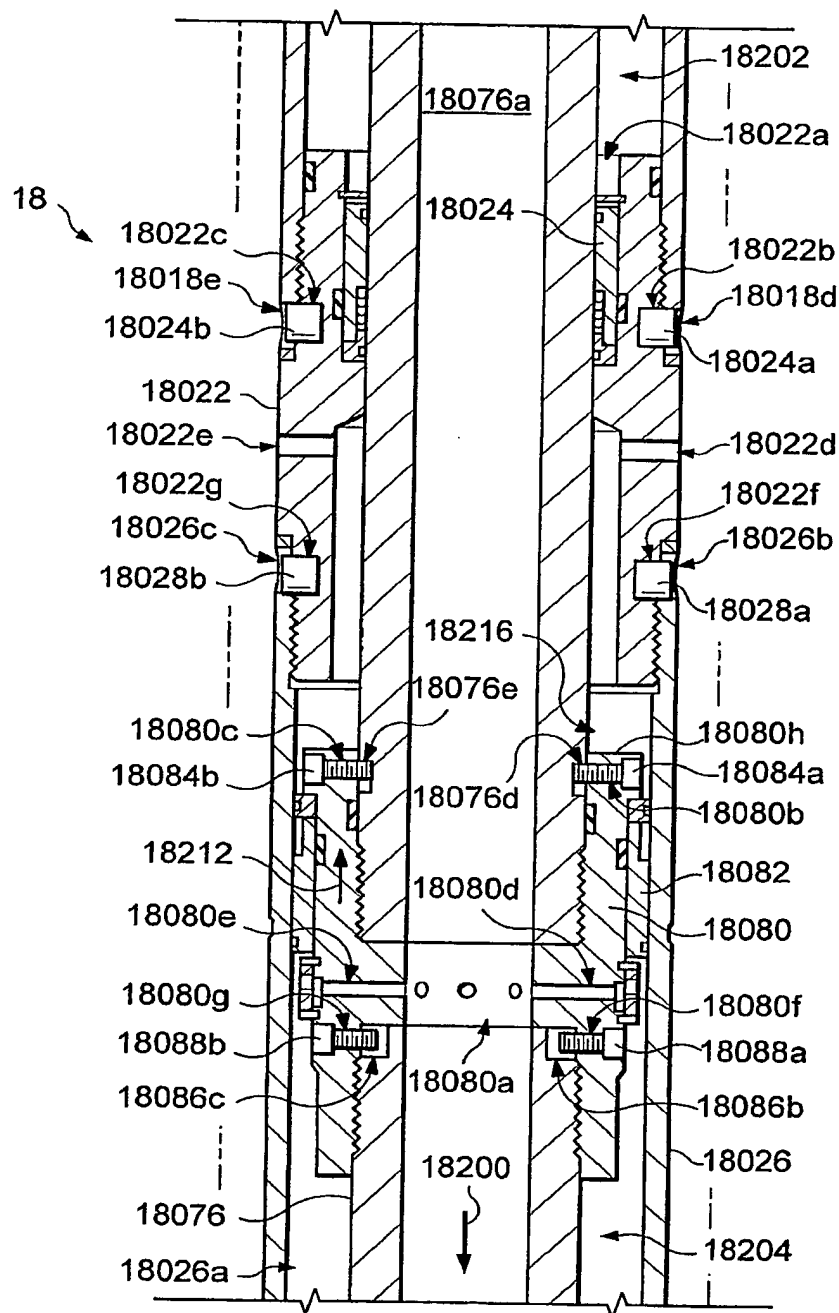
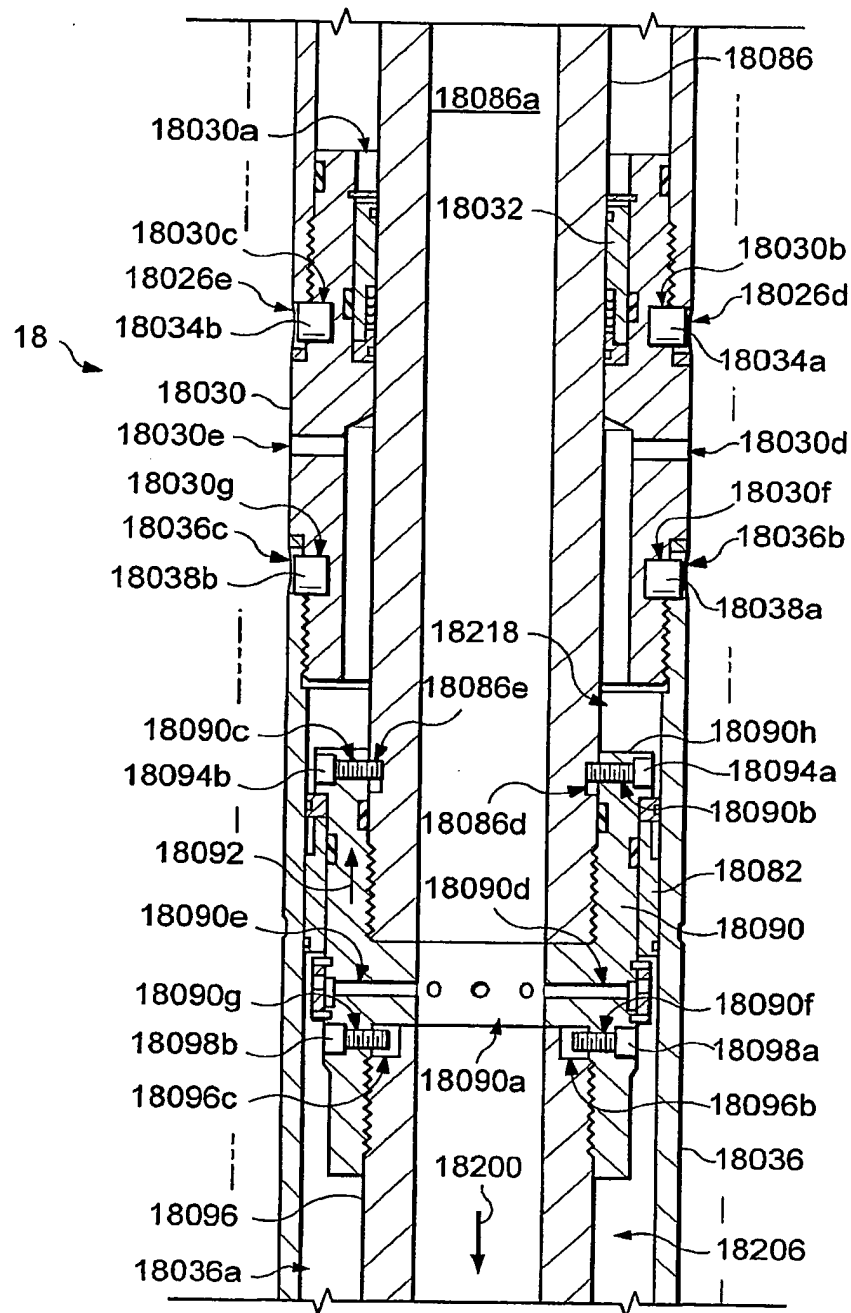
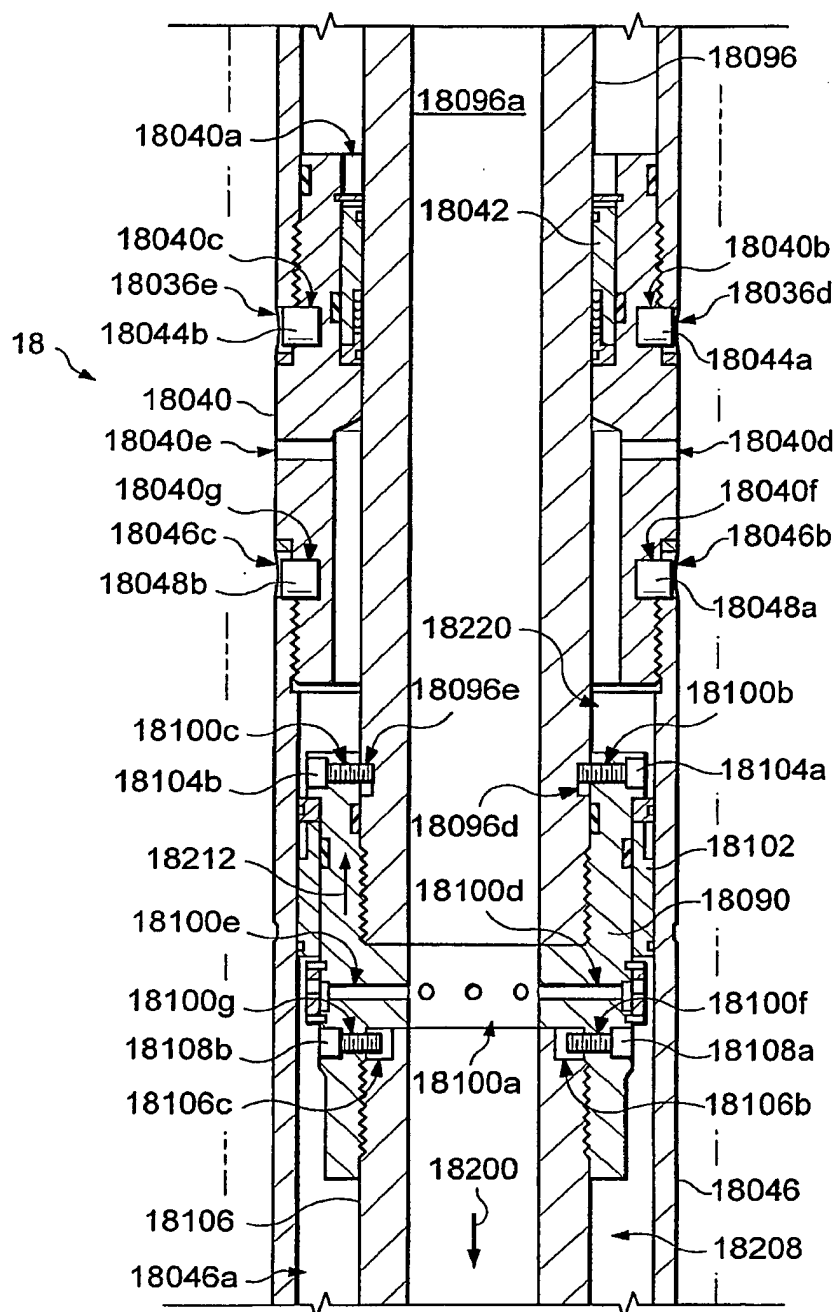


Fig. 13B3

*Fig. 13B4*

*Fig. 13B5*

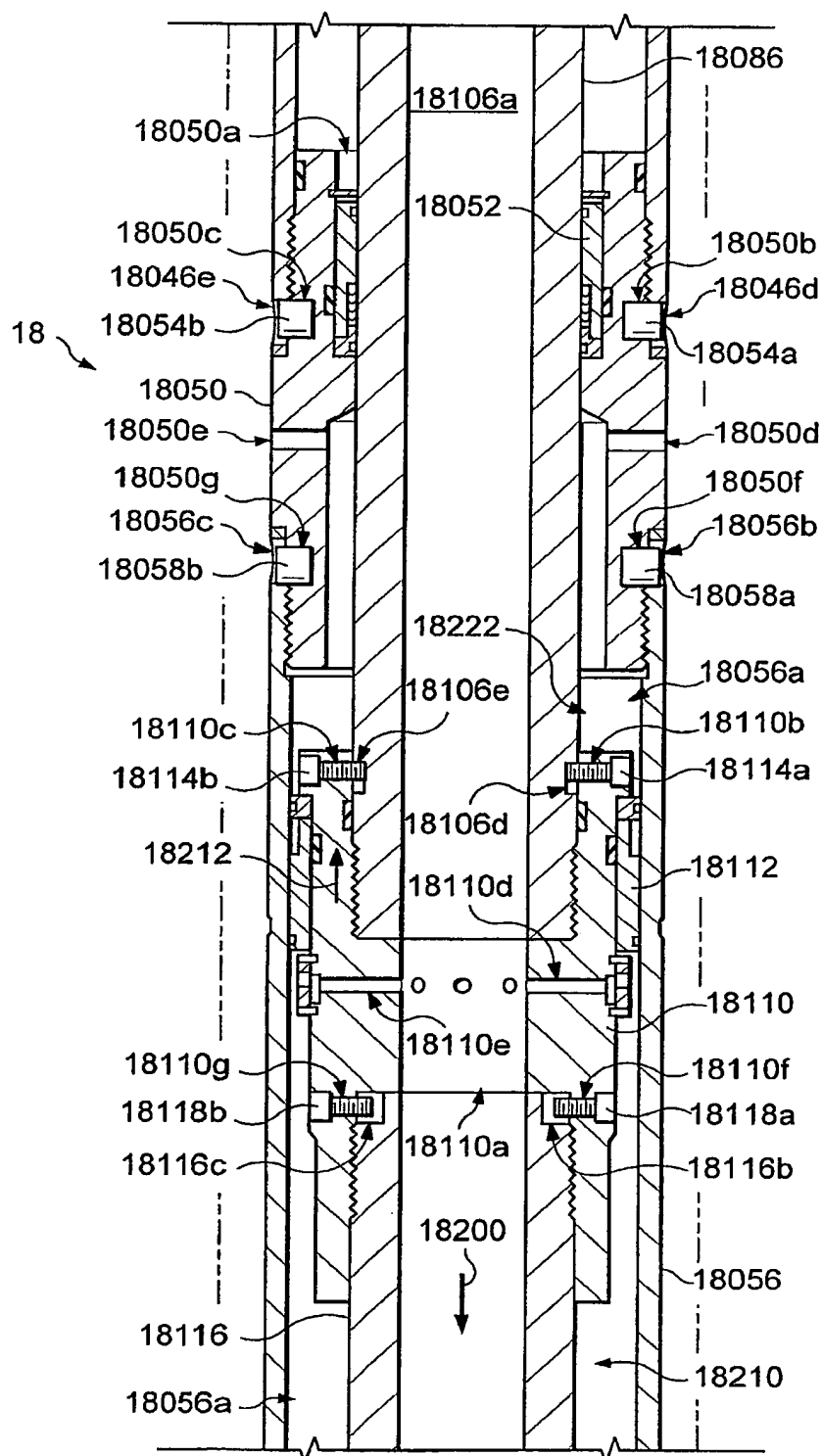


Fig. 13B6

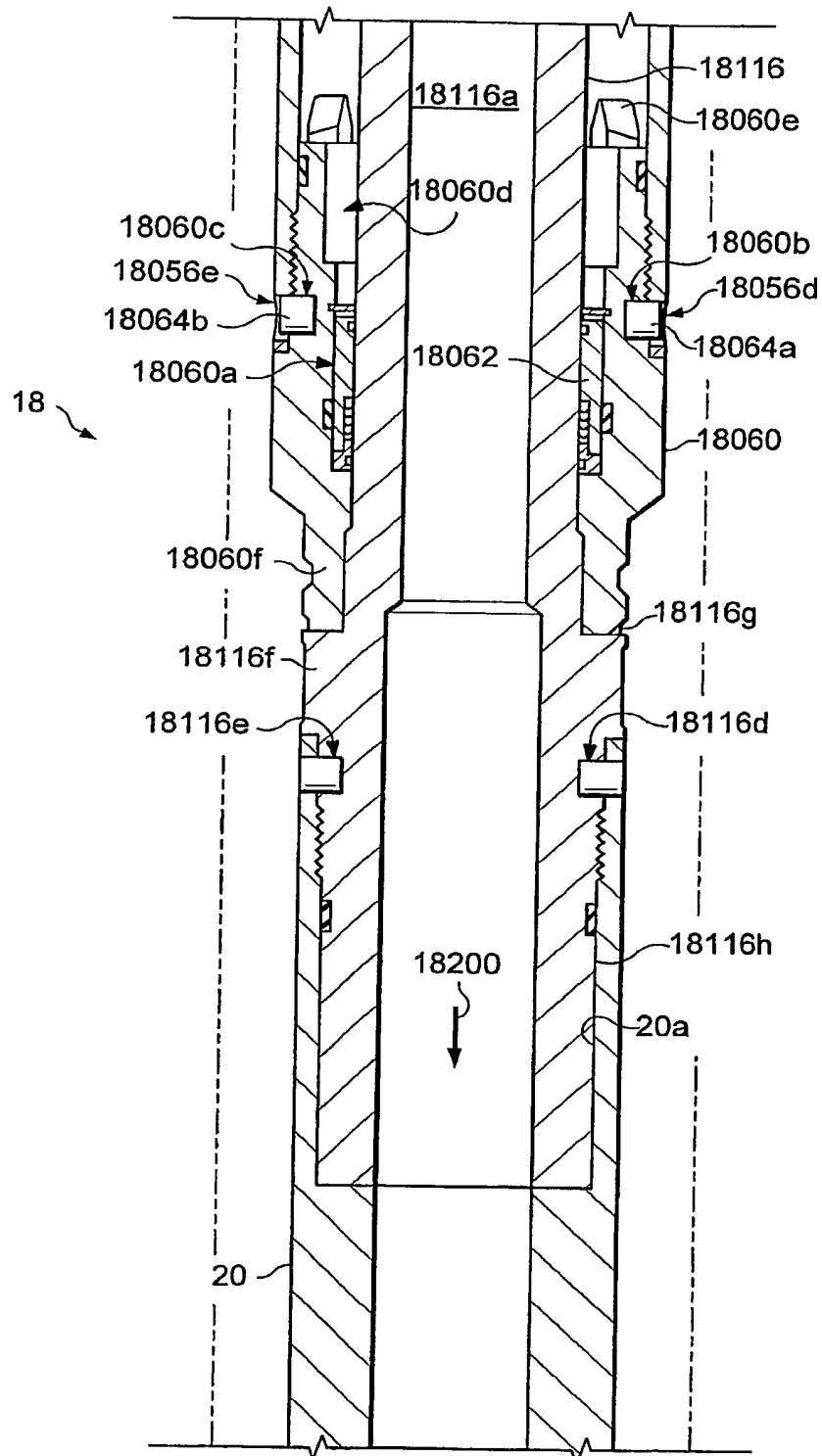
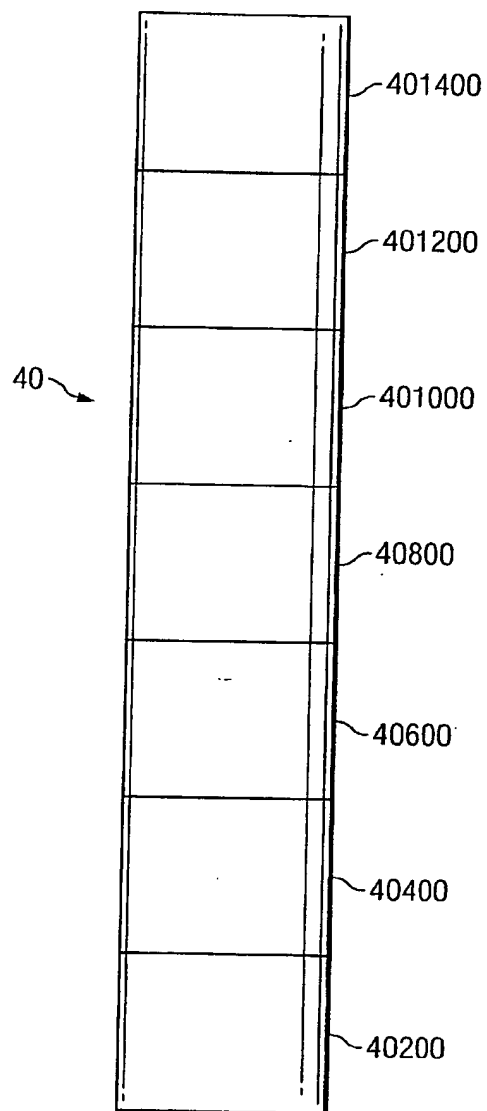


Fig. 13B7

*Fig. 34*

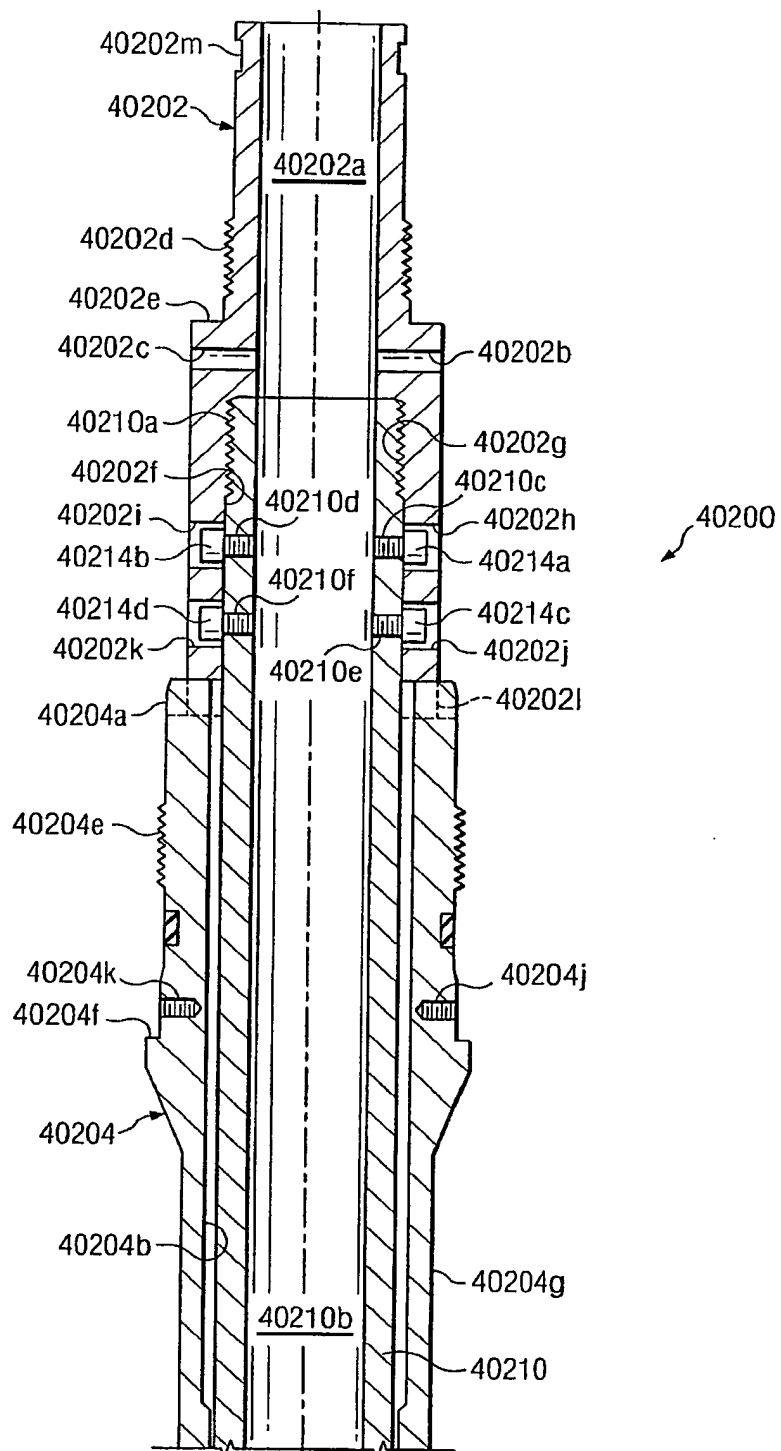
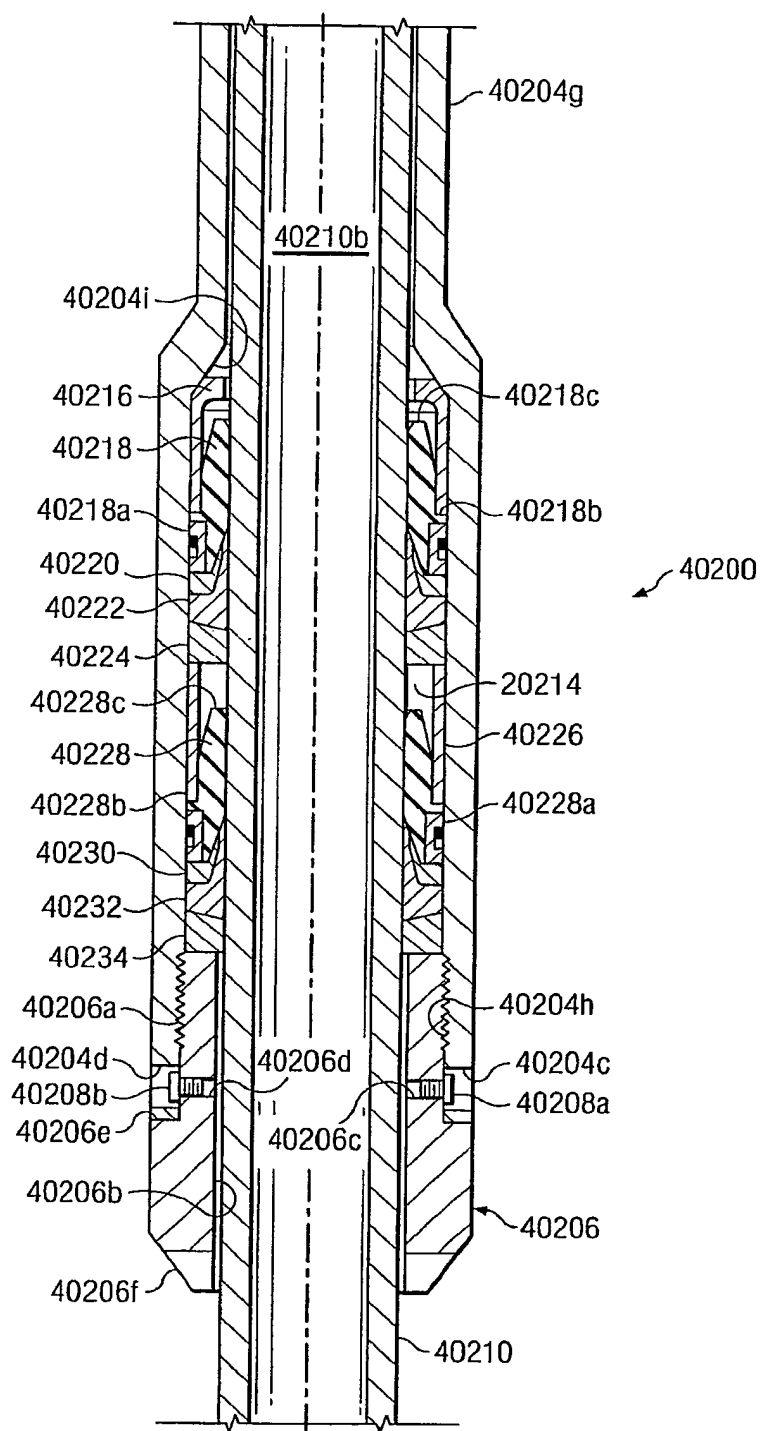
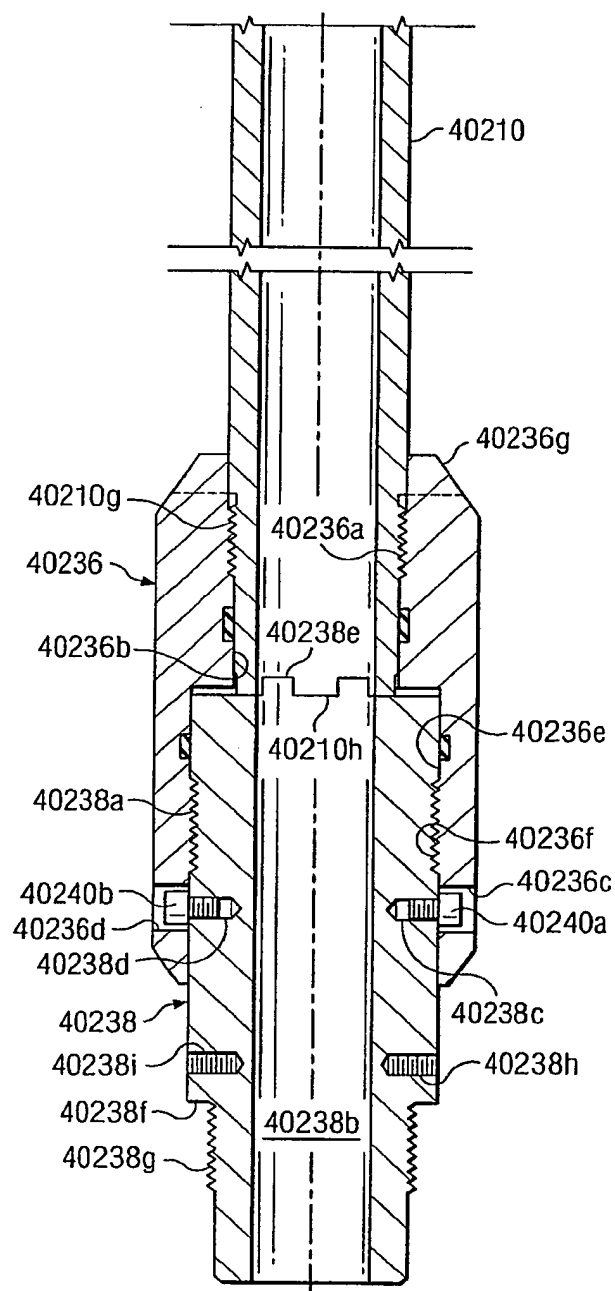
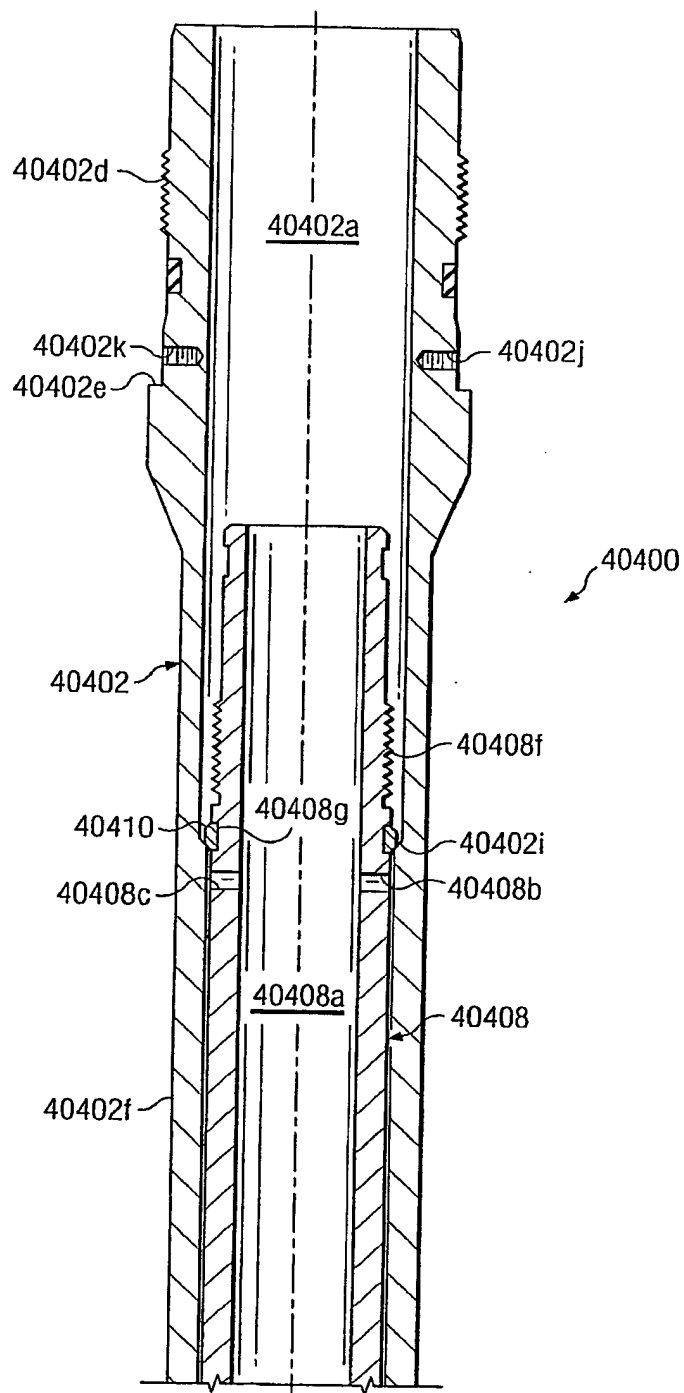
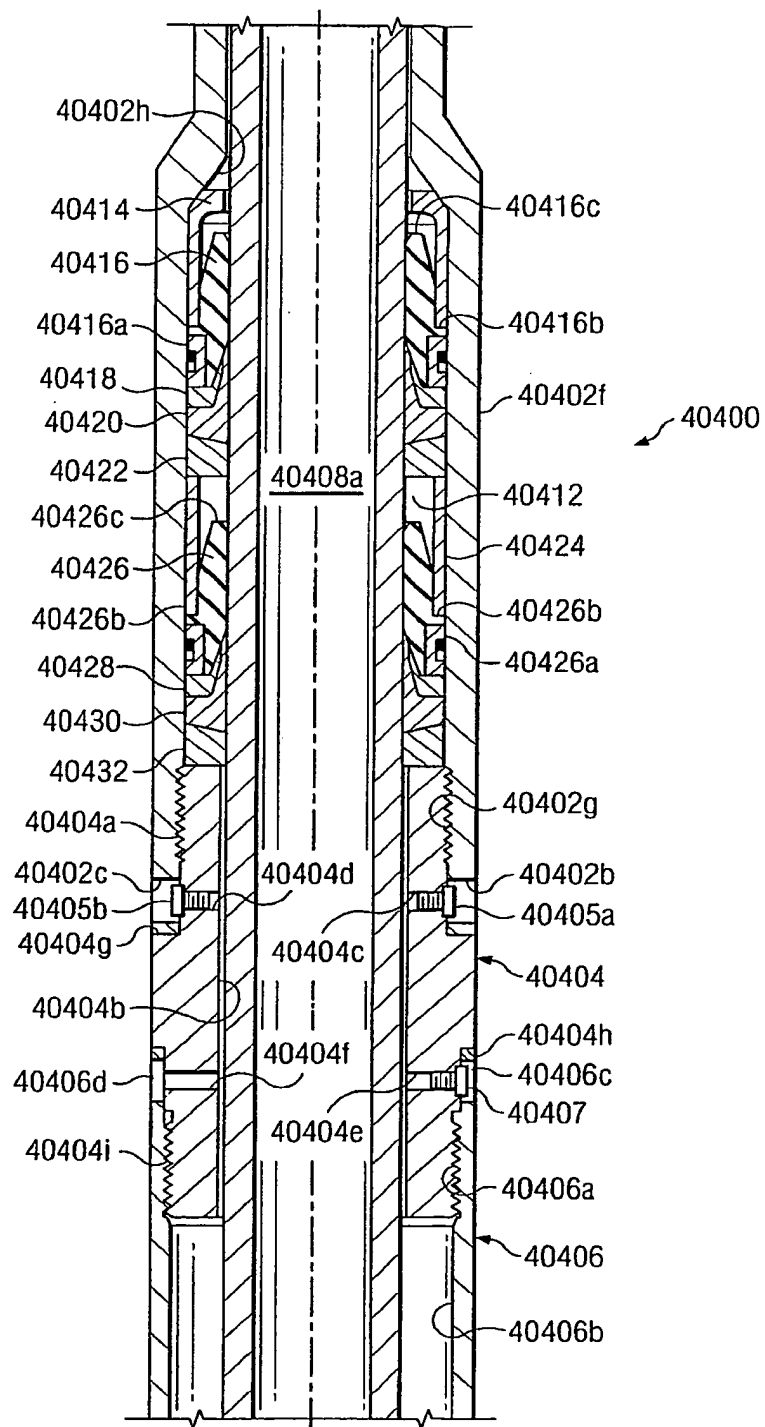


Fig. 35A

*Fig. 35B*

*Fig. 35C*

*Fig. 36A*

*Fig. 36B*

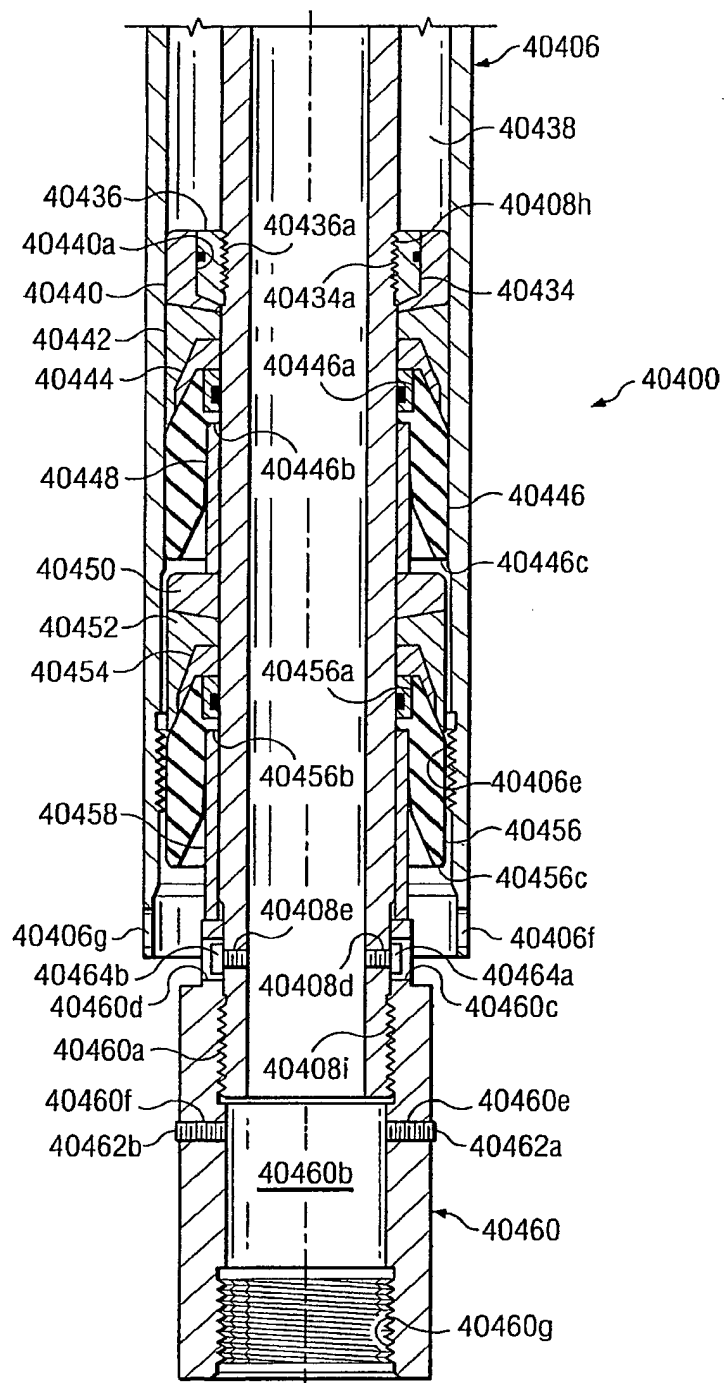
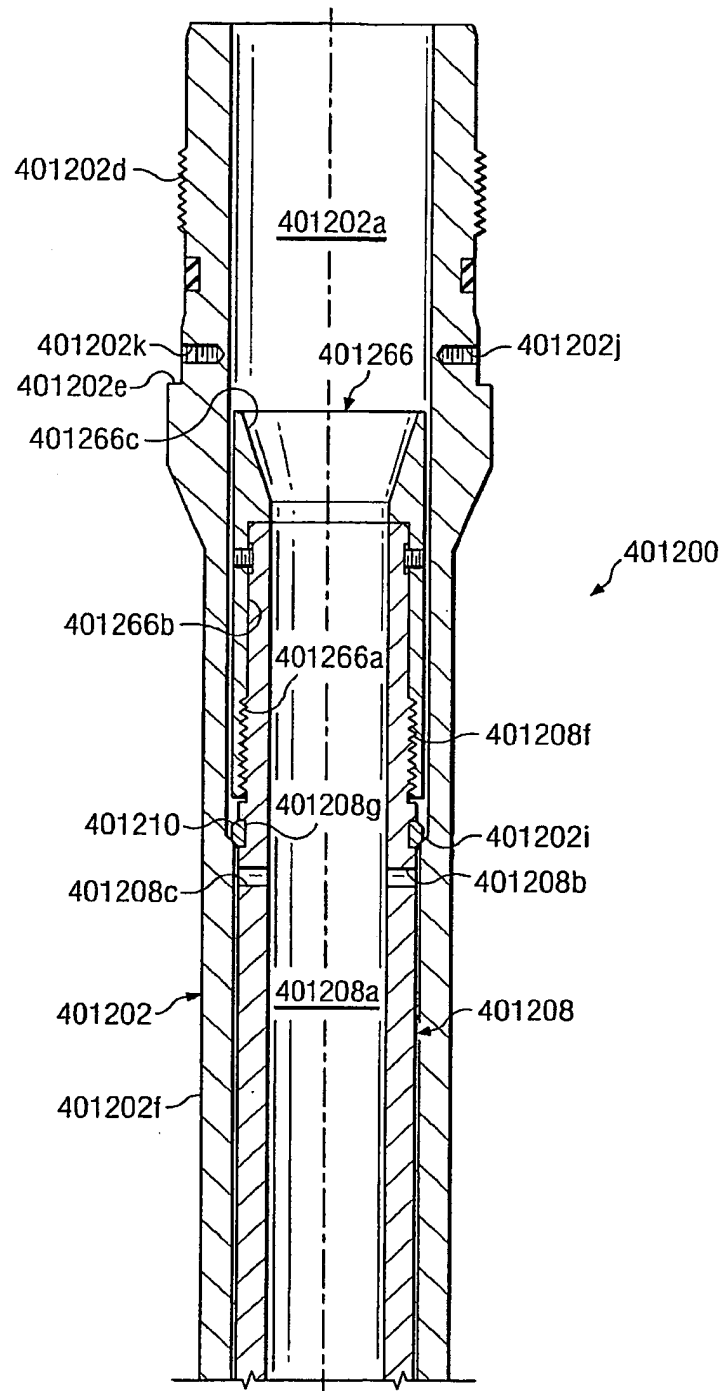
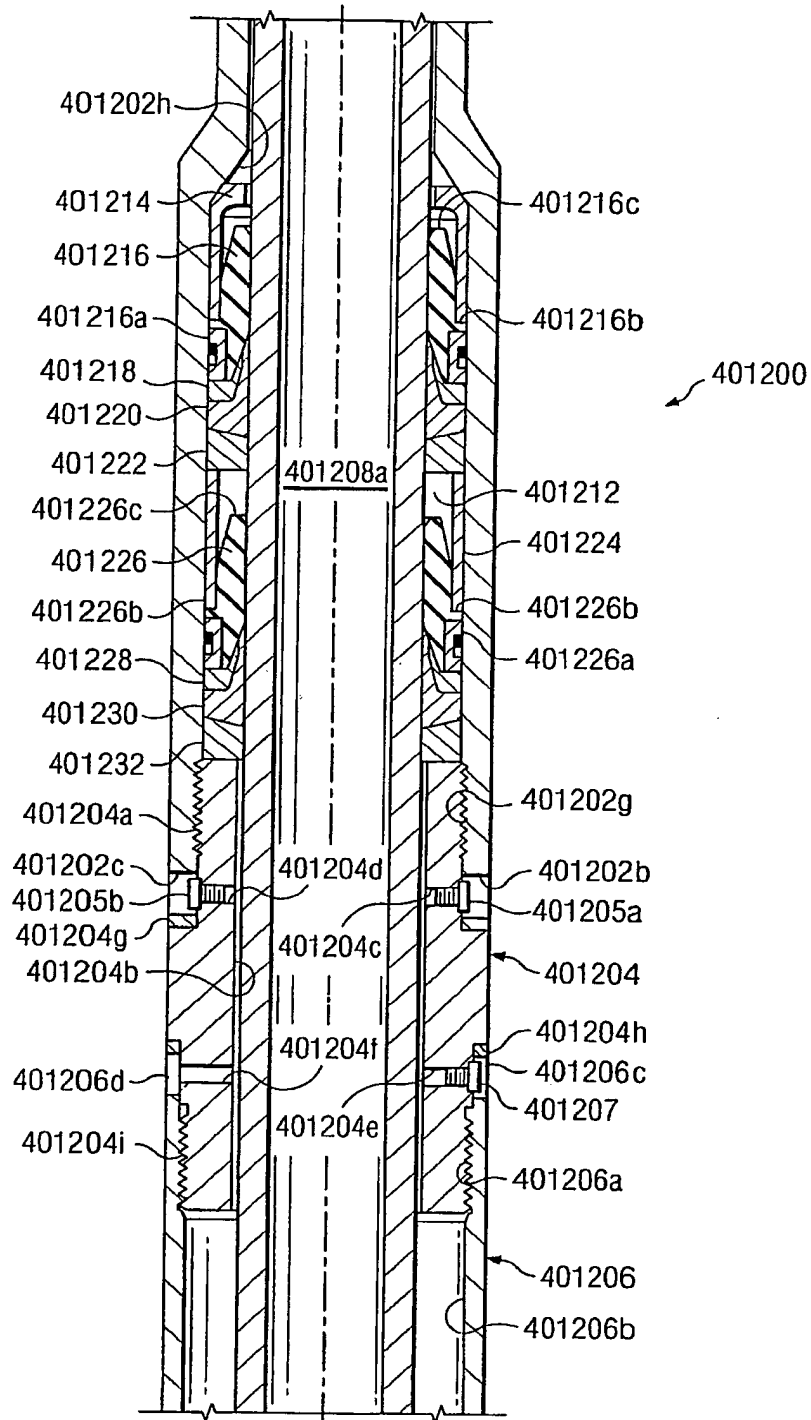
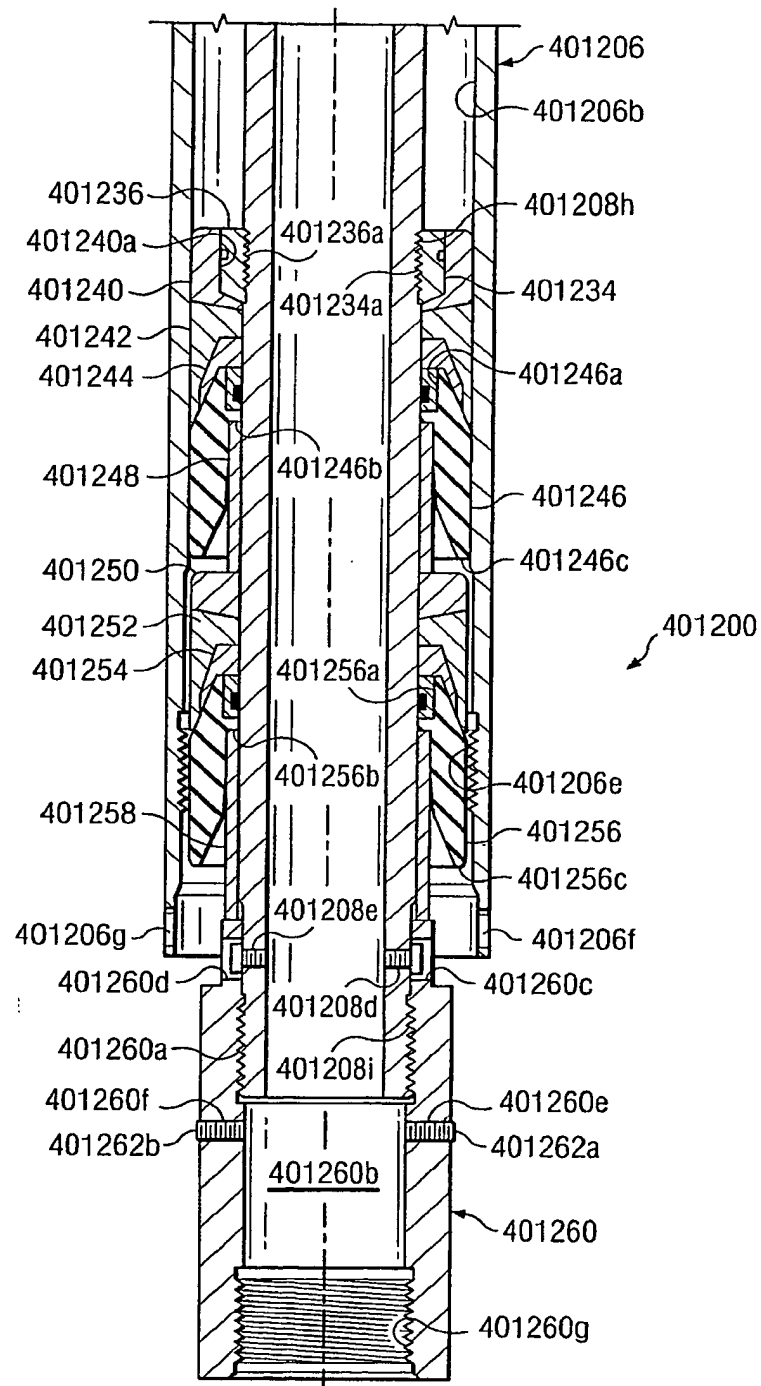
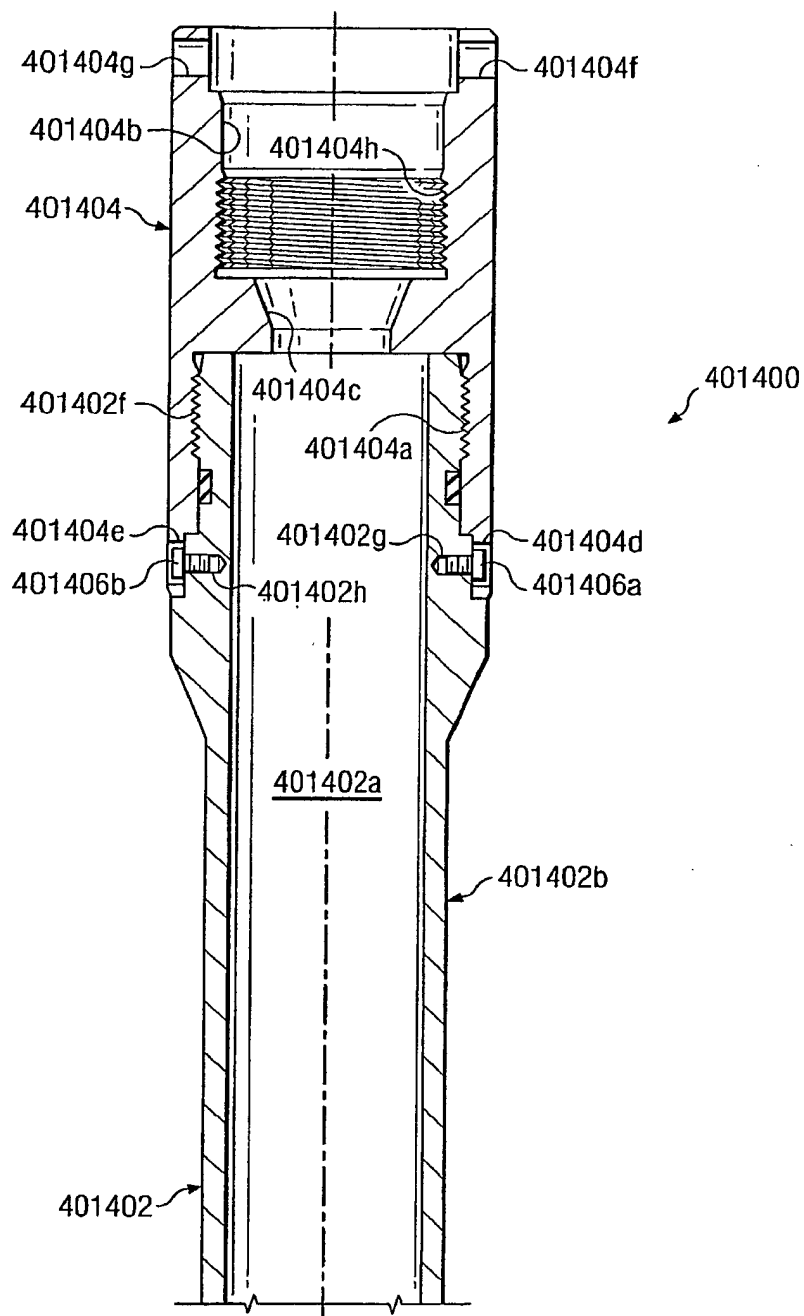


Fig. 36C

*Fig. 37A*

*Fig. 37B*

*Fig. 37C*

*Fig. 38A*

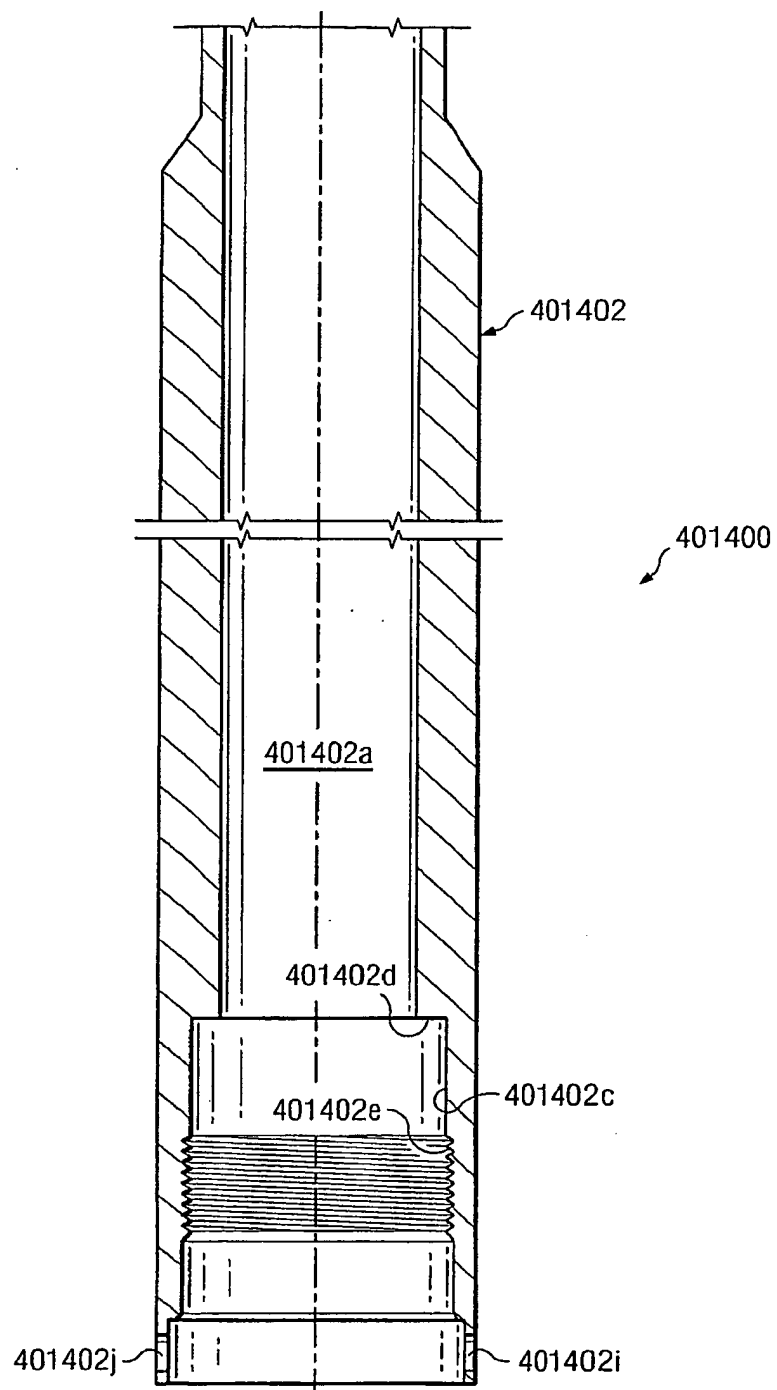
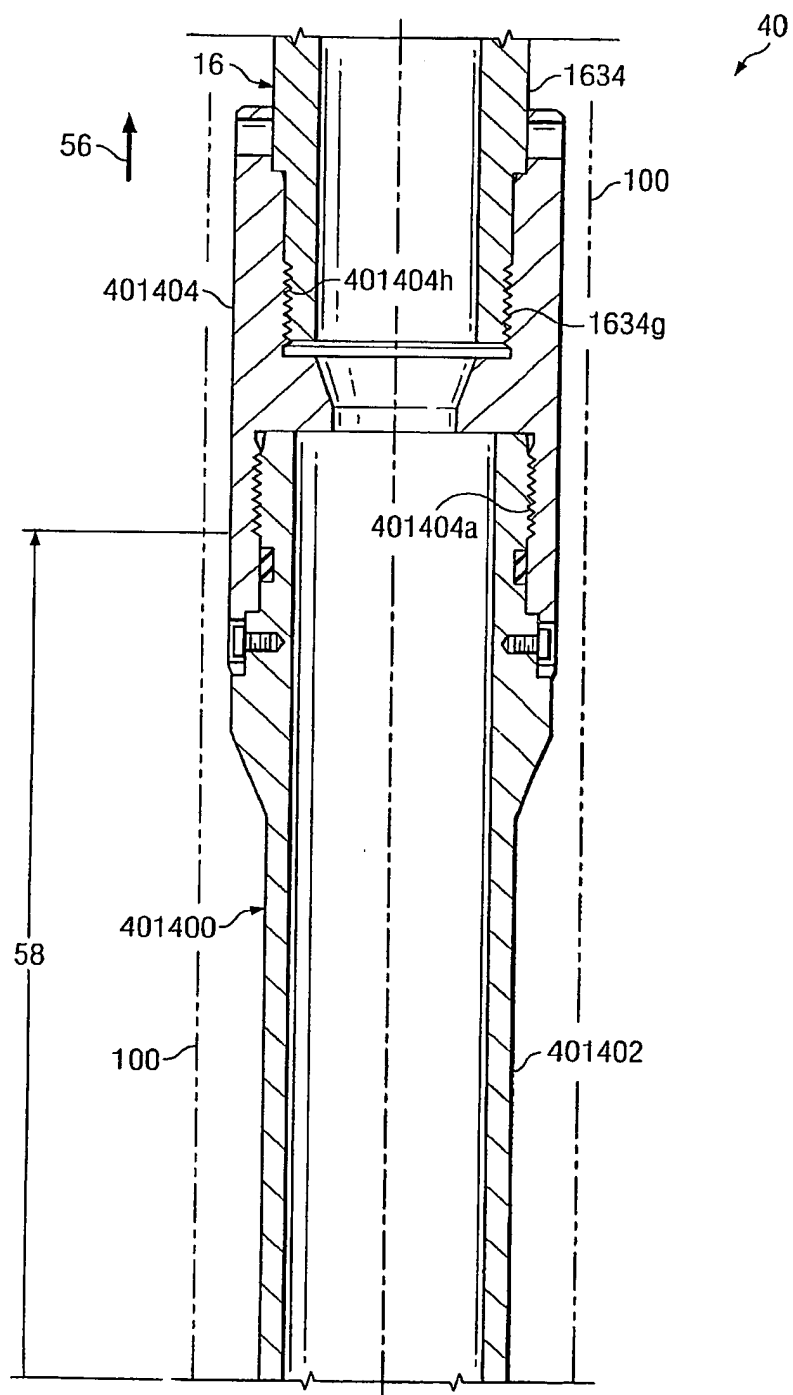
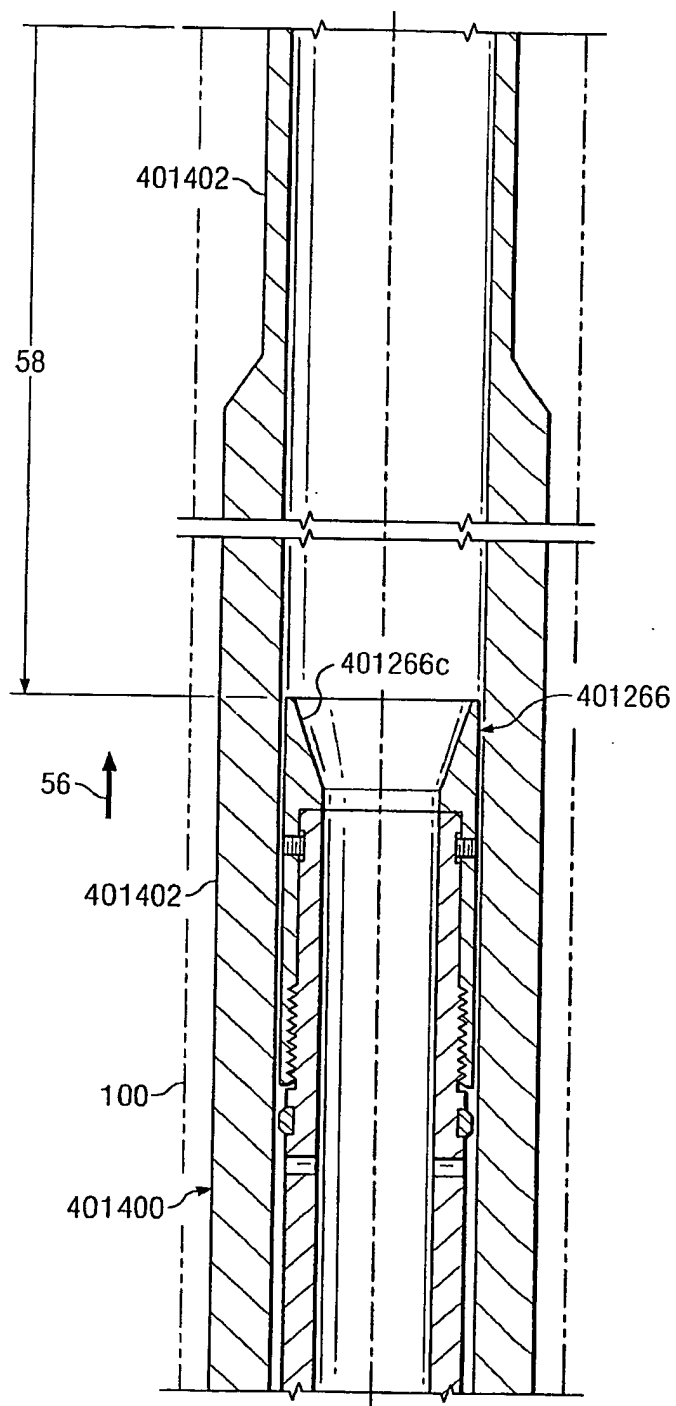


Fig. 38B

*Fig. 39A*

*Fig. 39B*

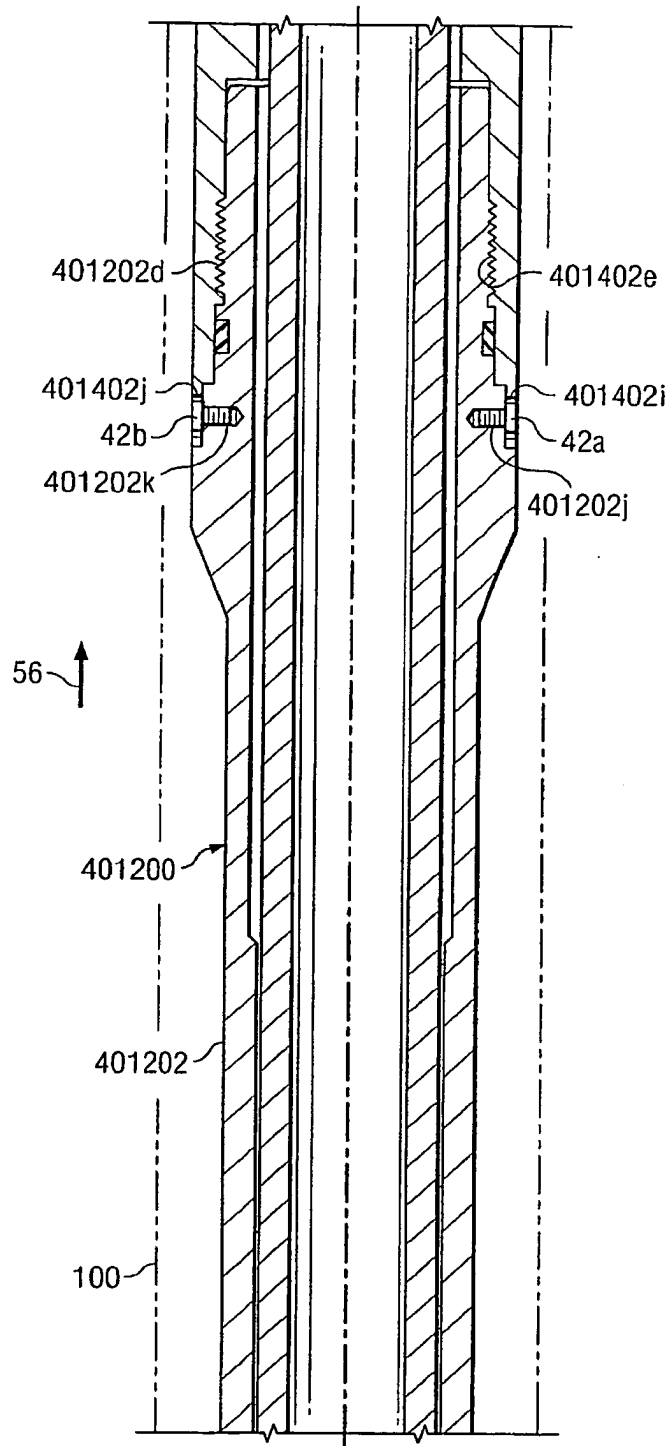


Fig. 39C

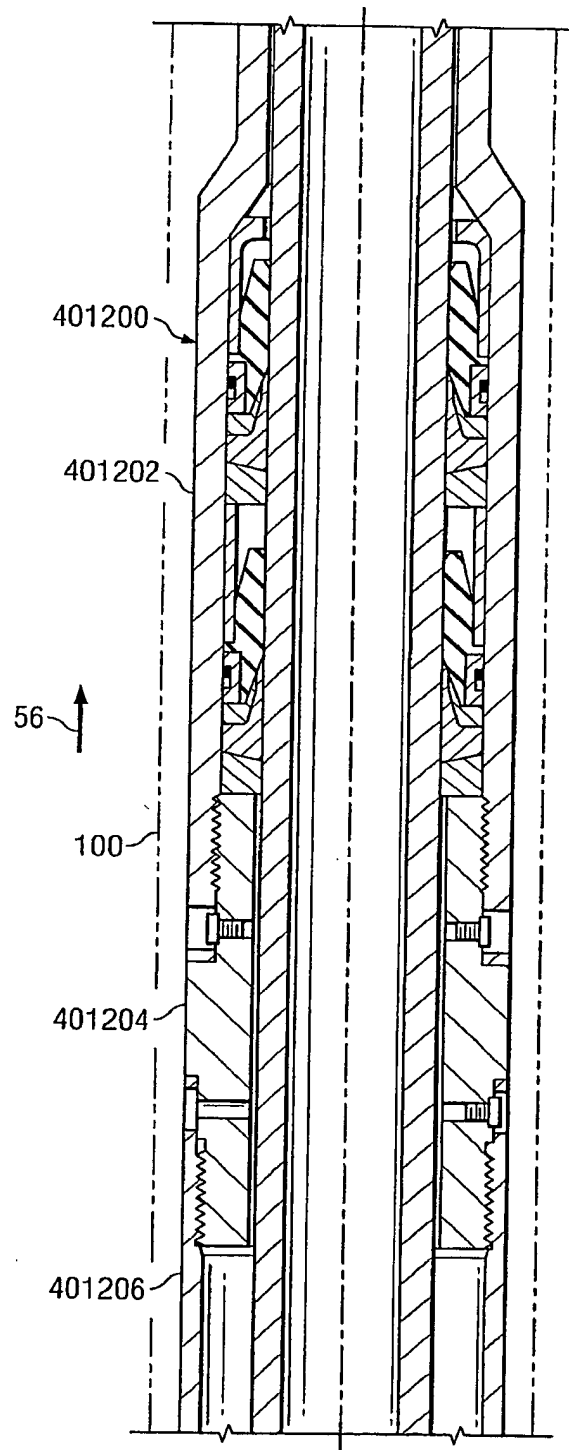


Fig. 39D

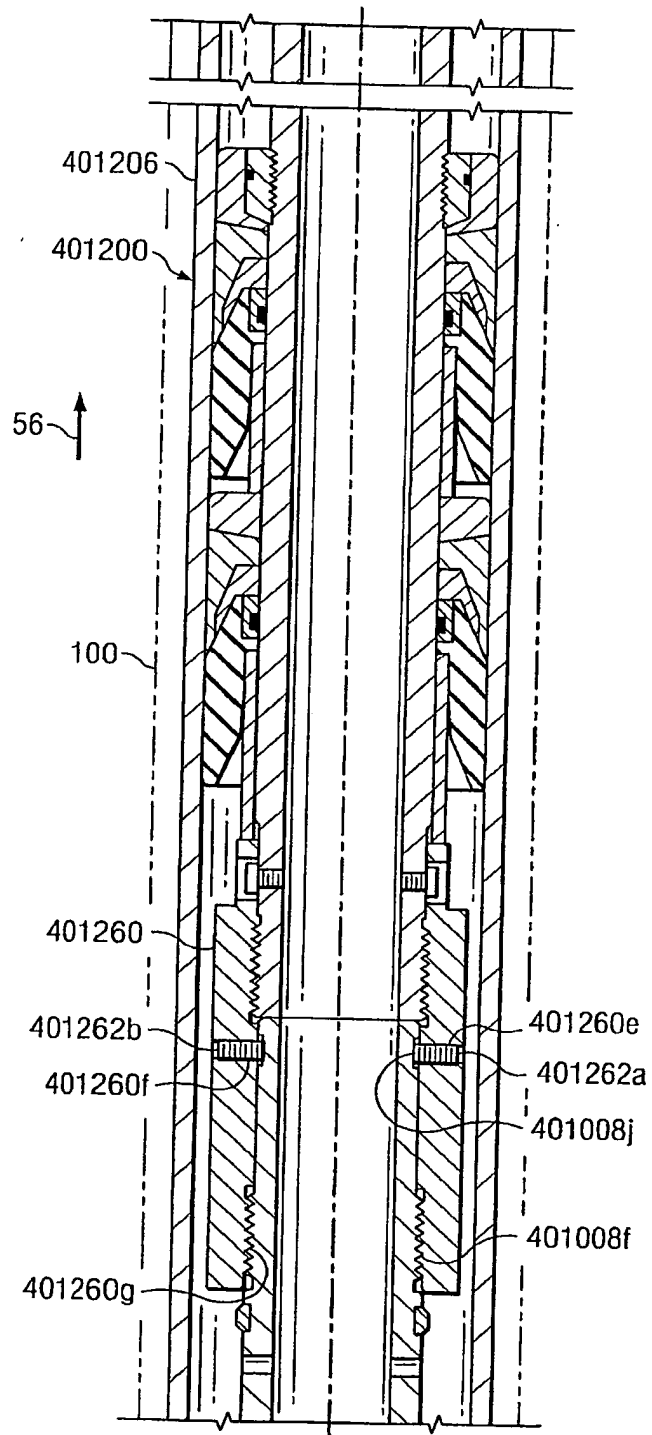
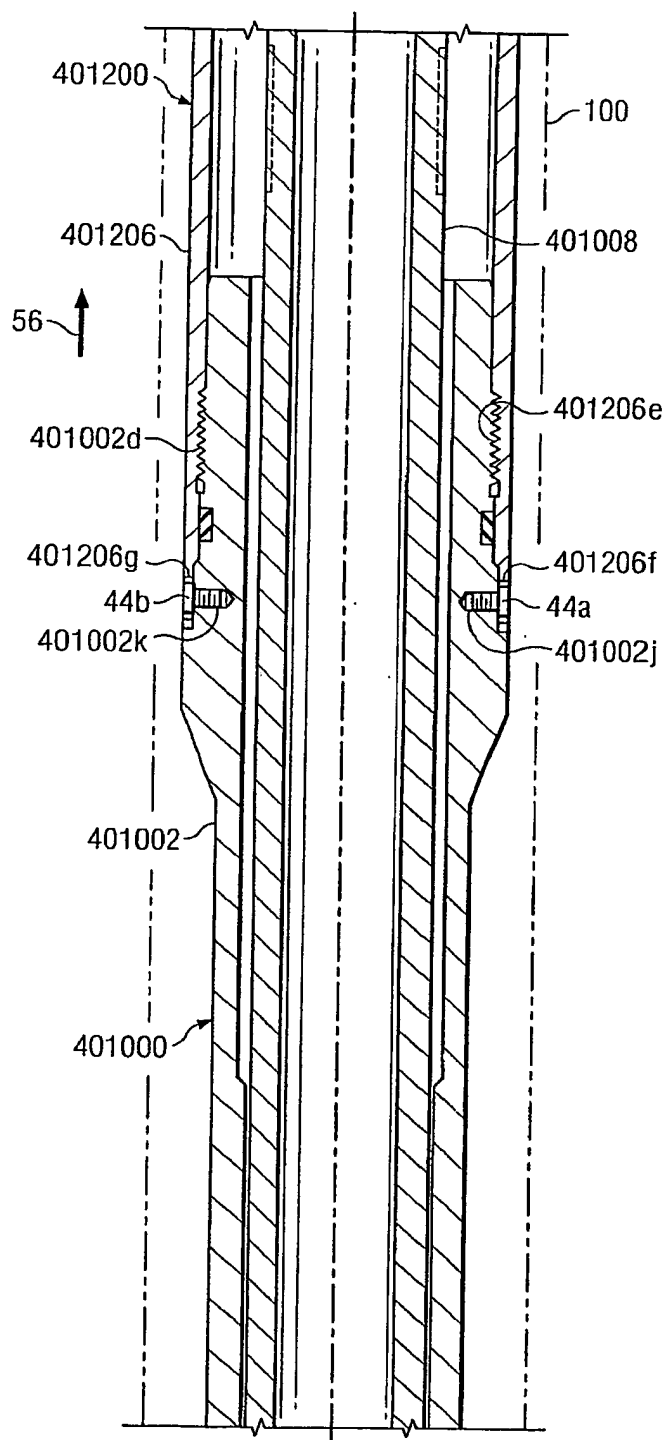


Fig. 39E

*Fig. 39F*

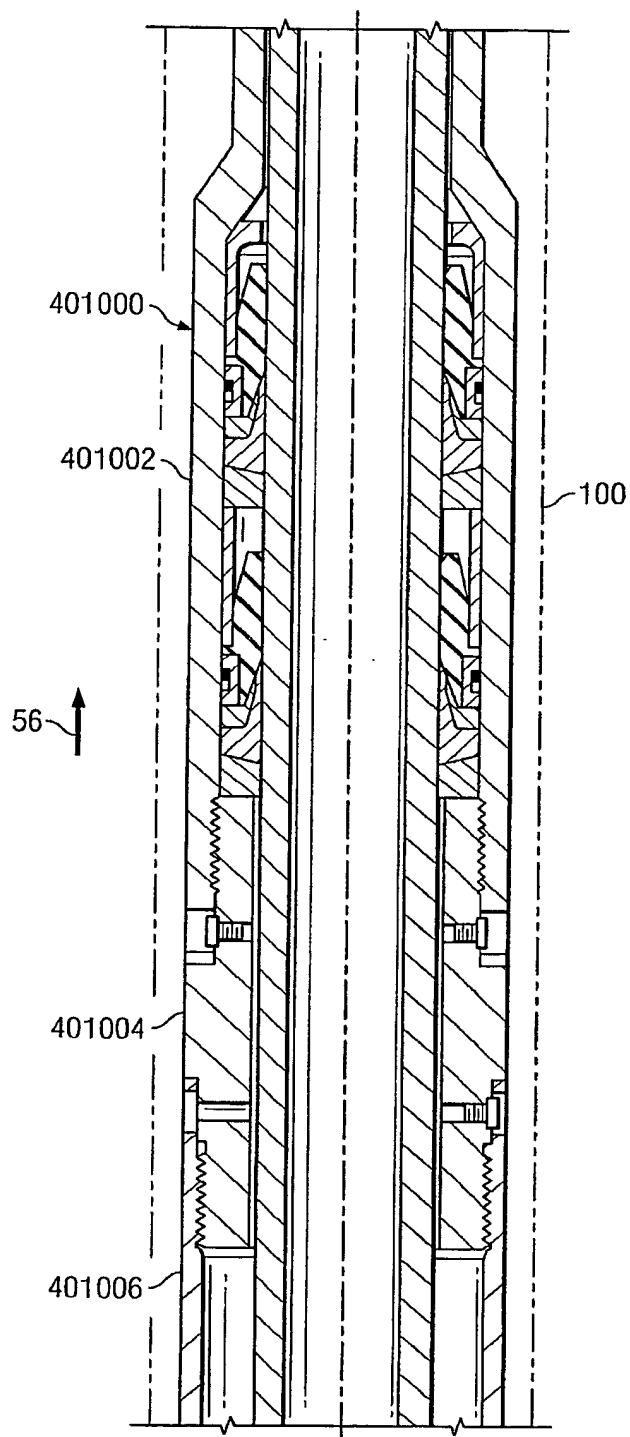


Fig. 39G

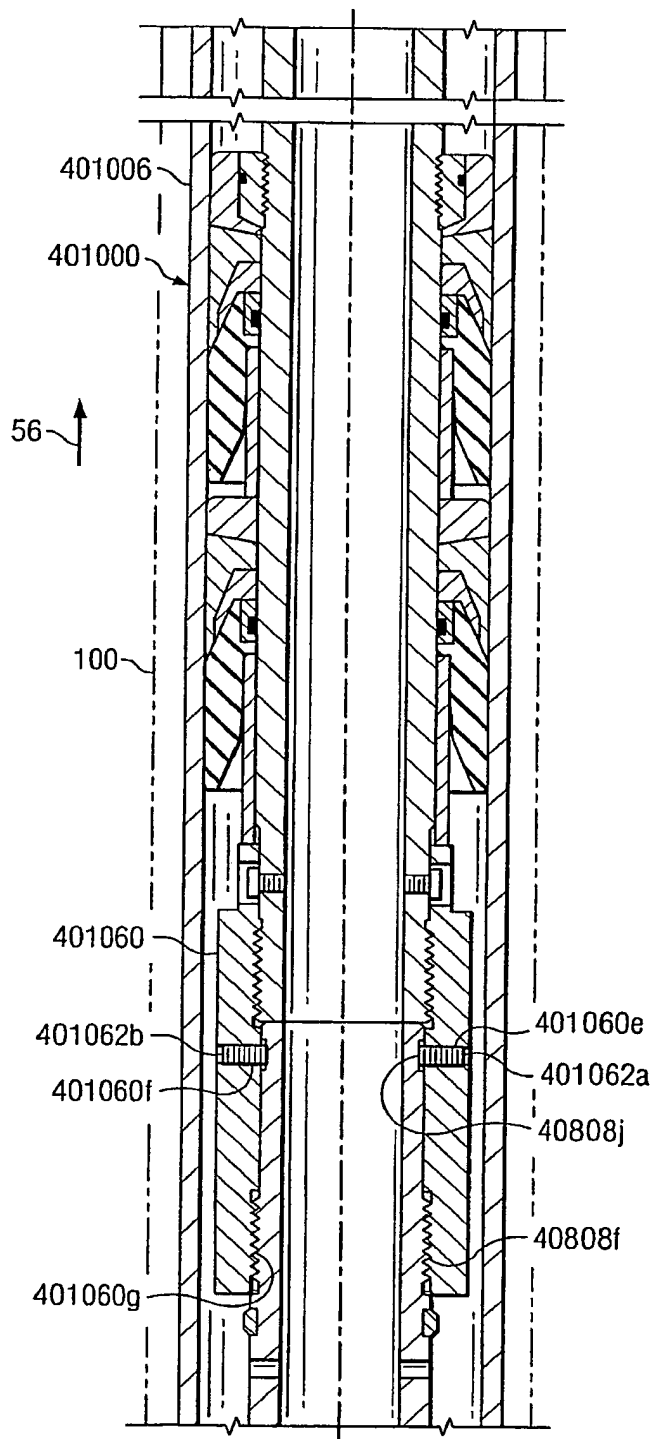
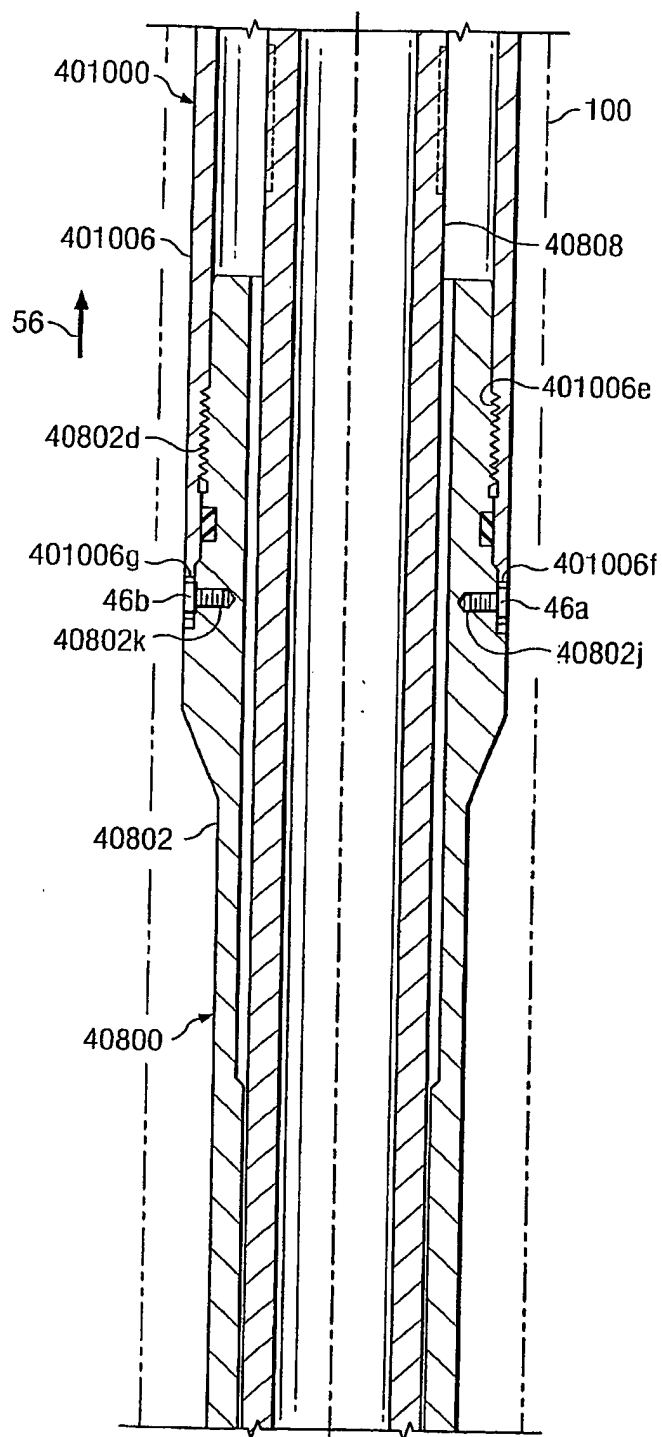
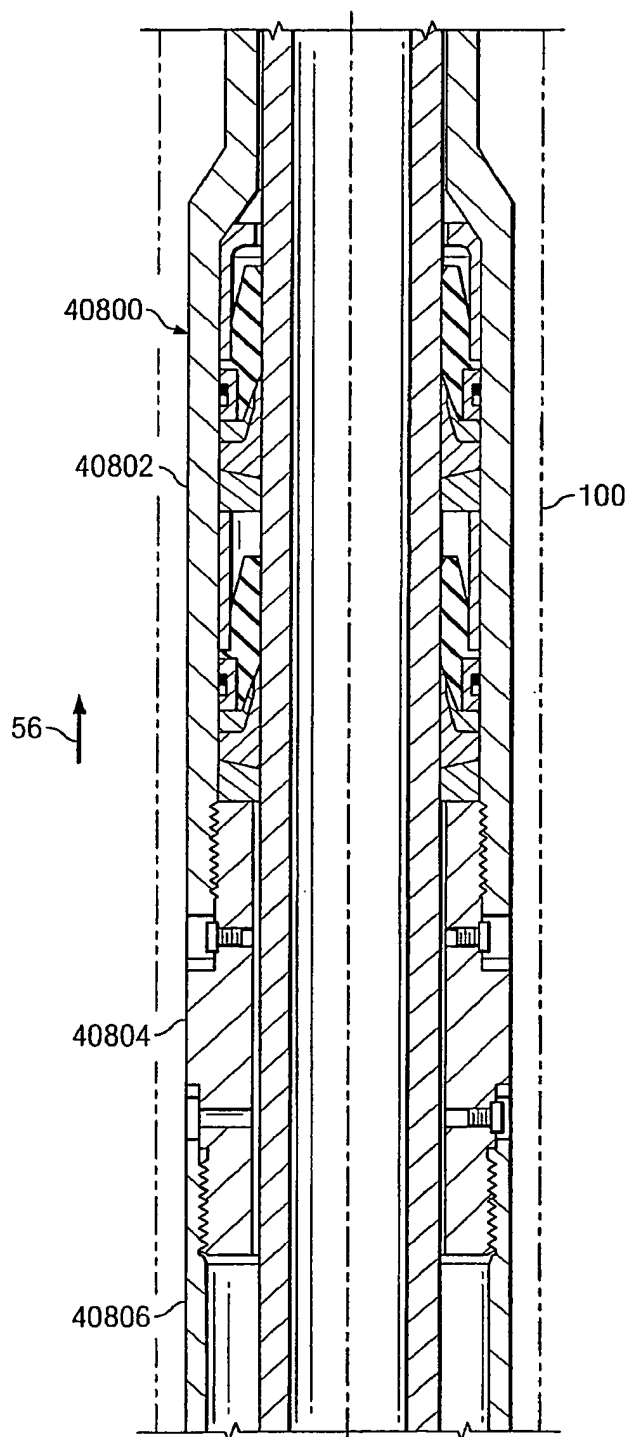


Fig. 39H

*Fig. 39I*

*Fig. 39J*

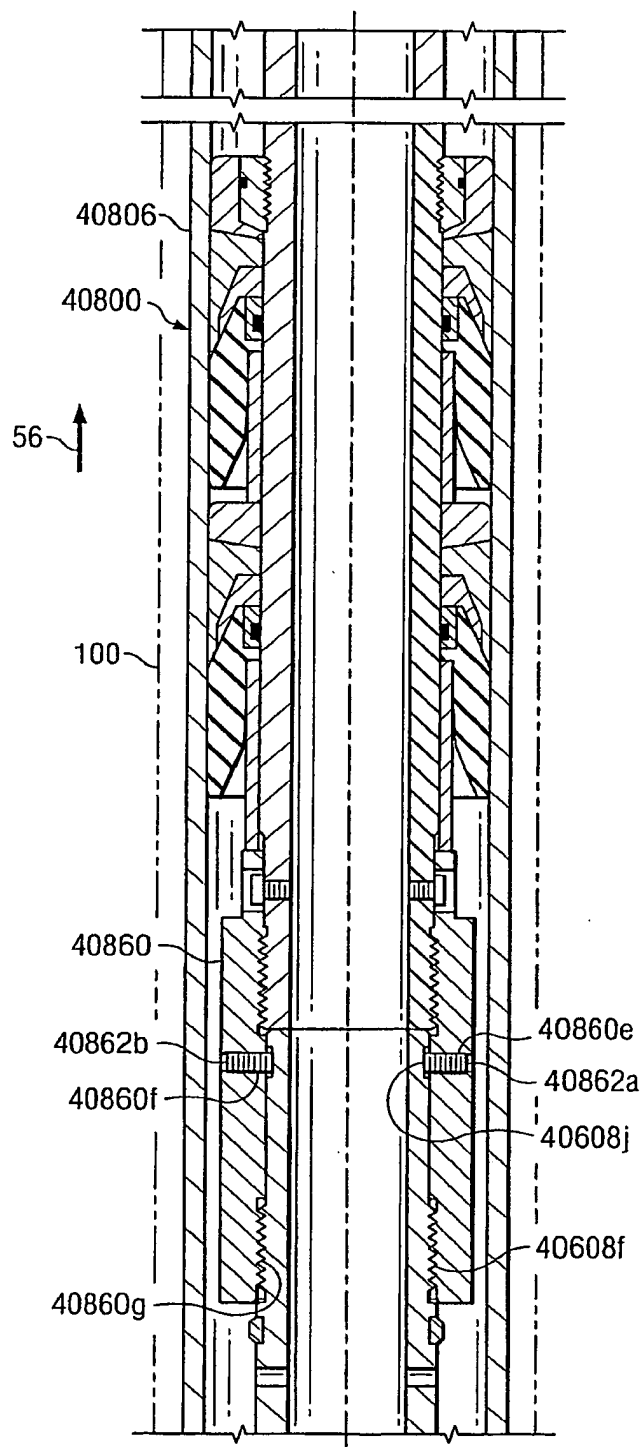
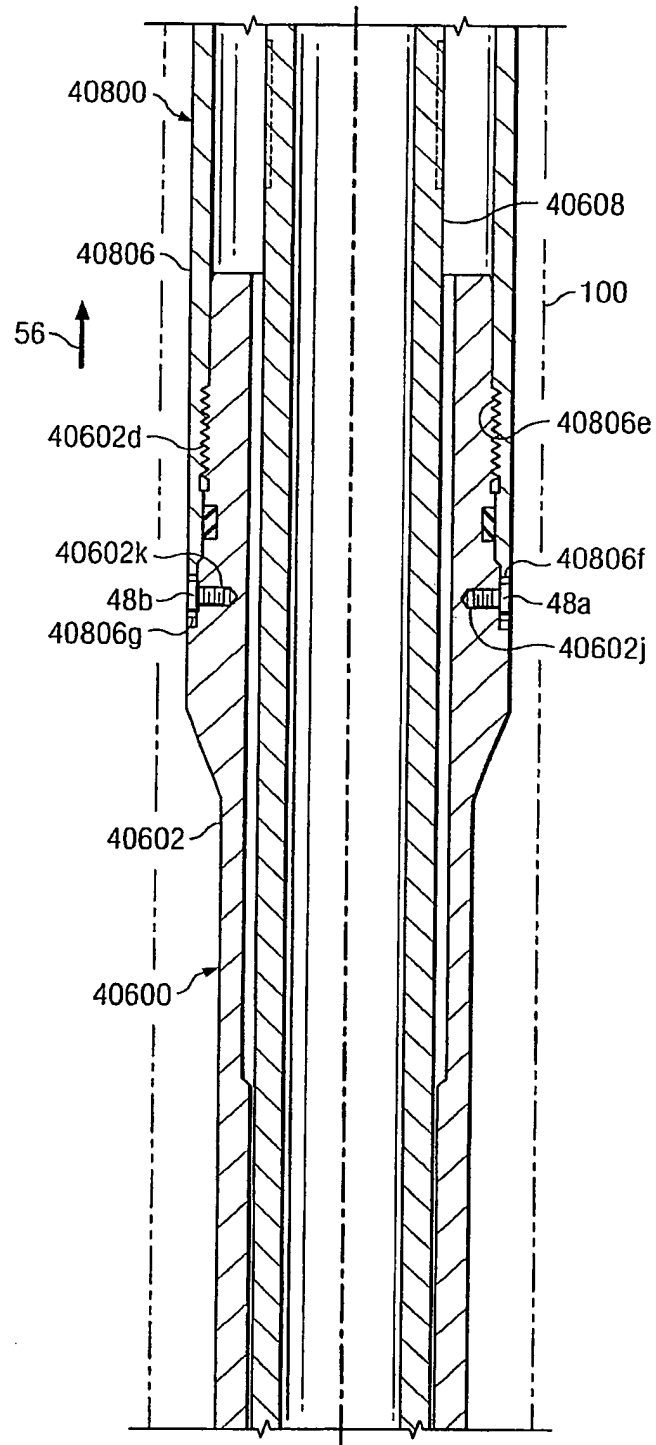
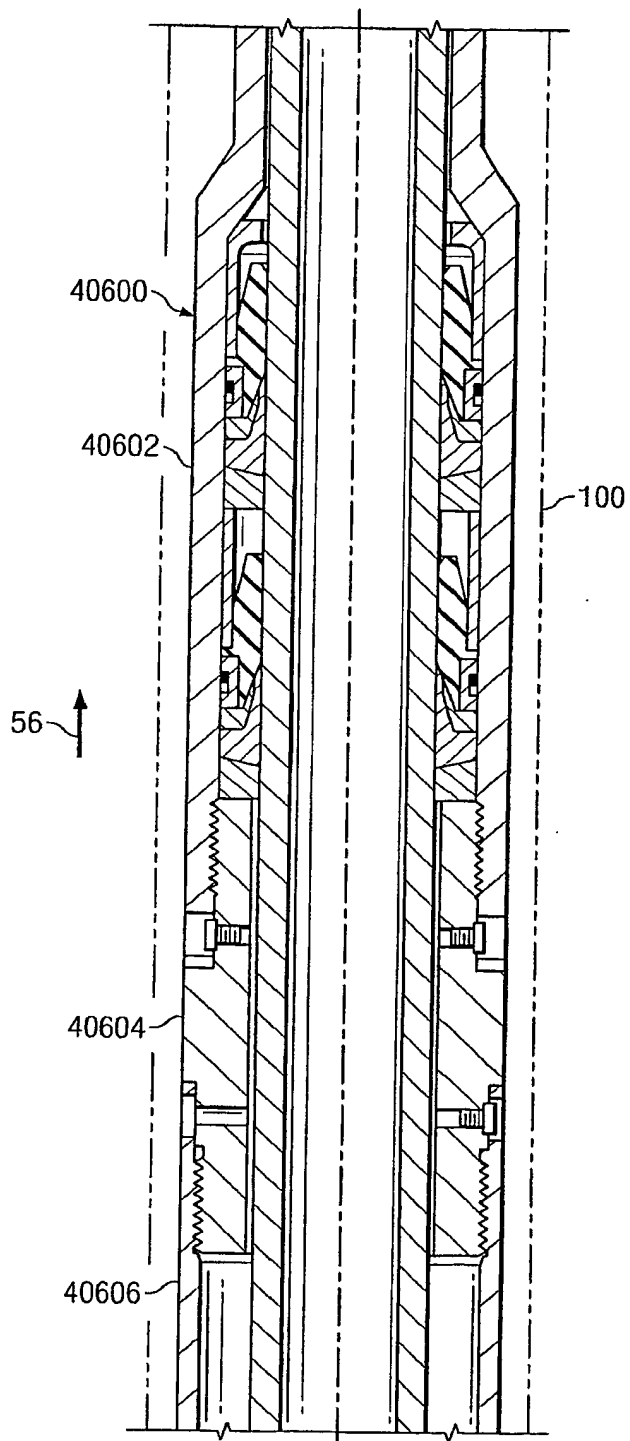
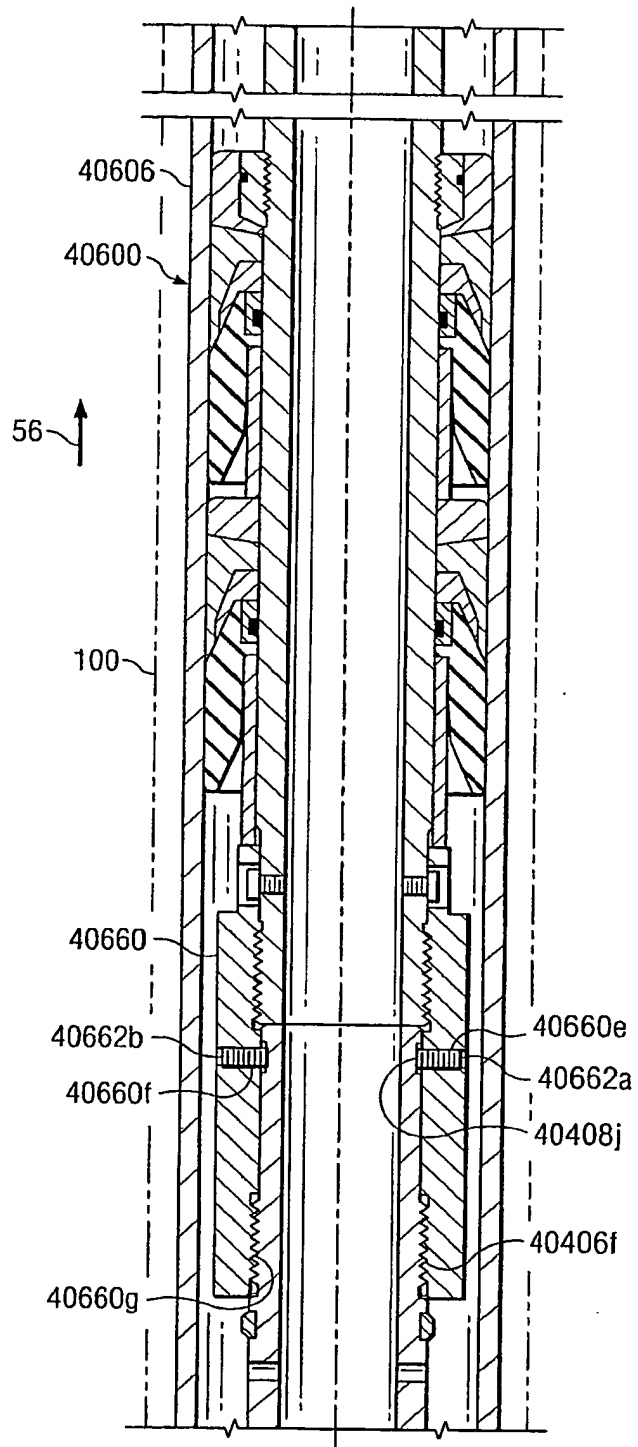
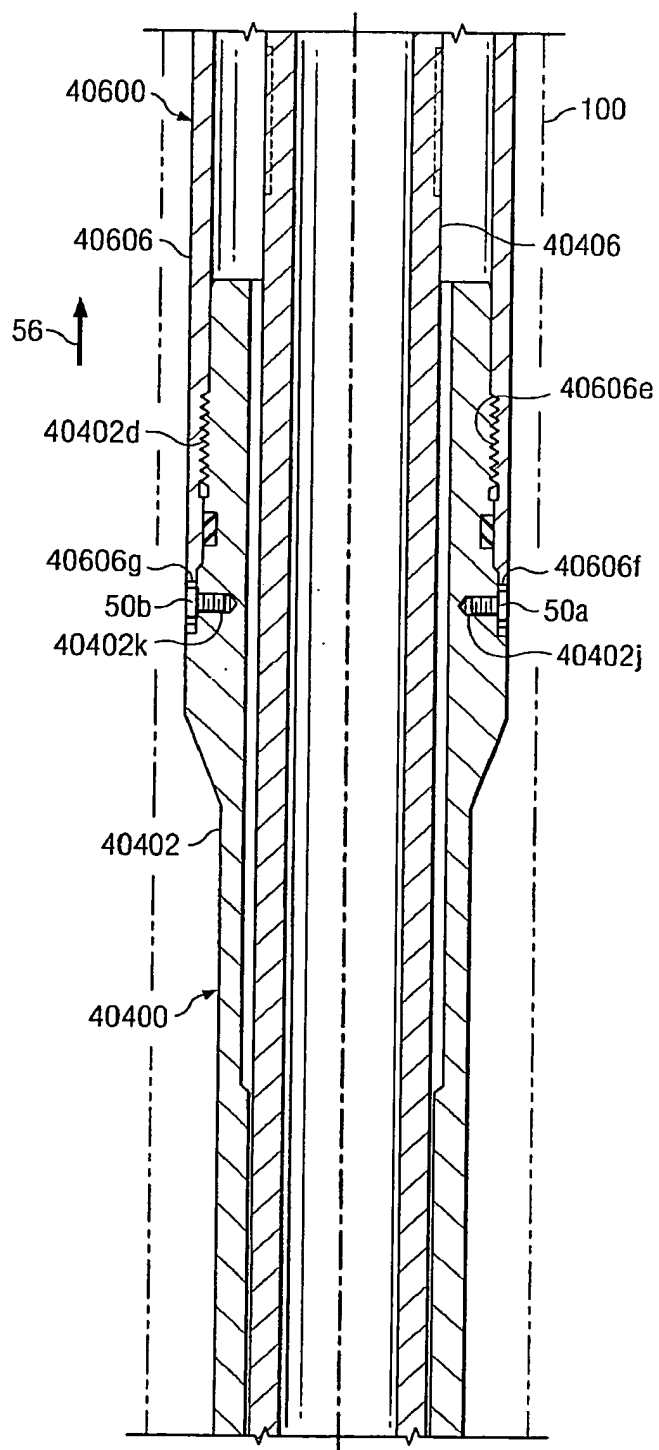


Fig. 39K

*Fig. 39L*

*Fig. 39M*

*Fig. 39N*

*Fig. 390*

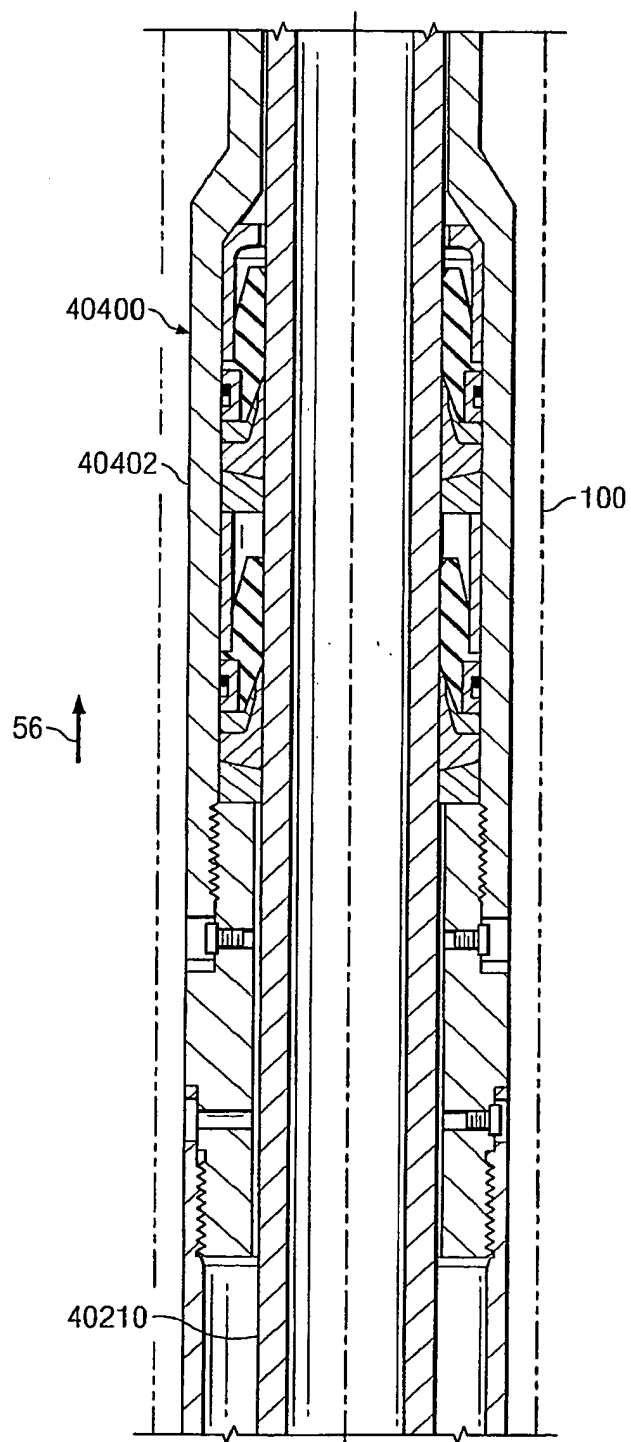
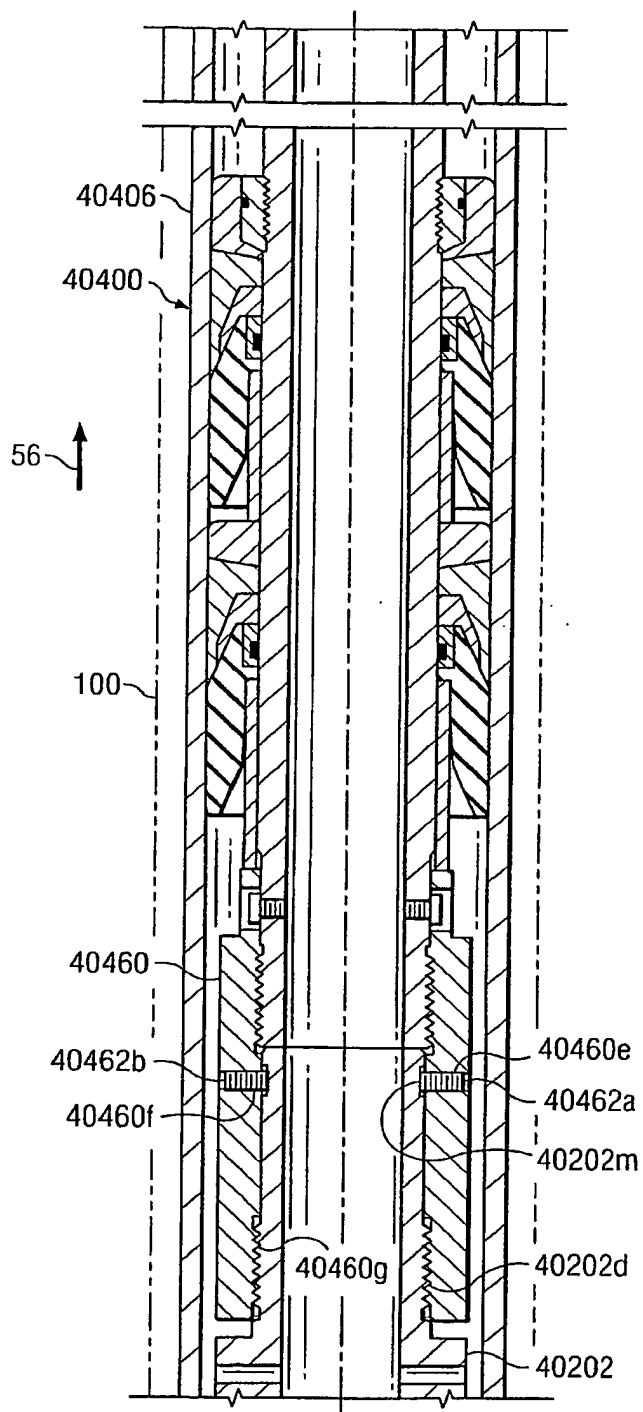
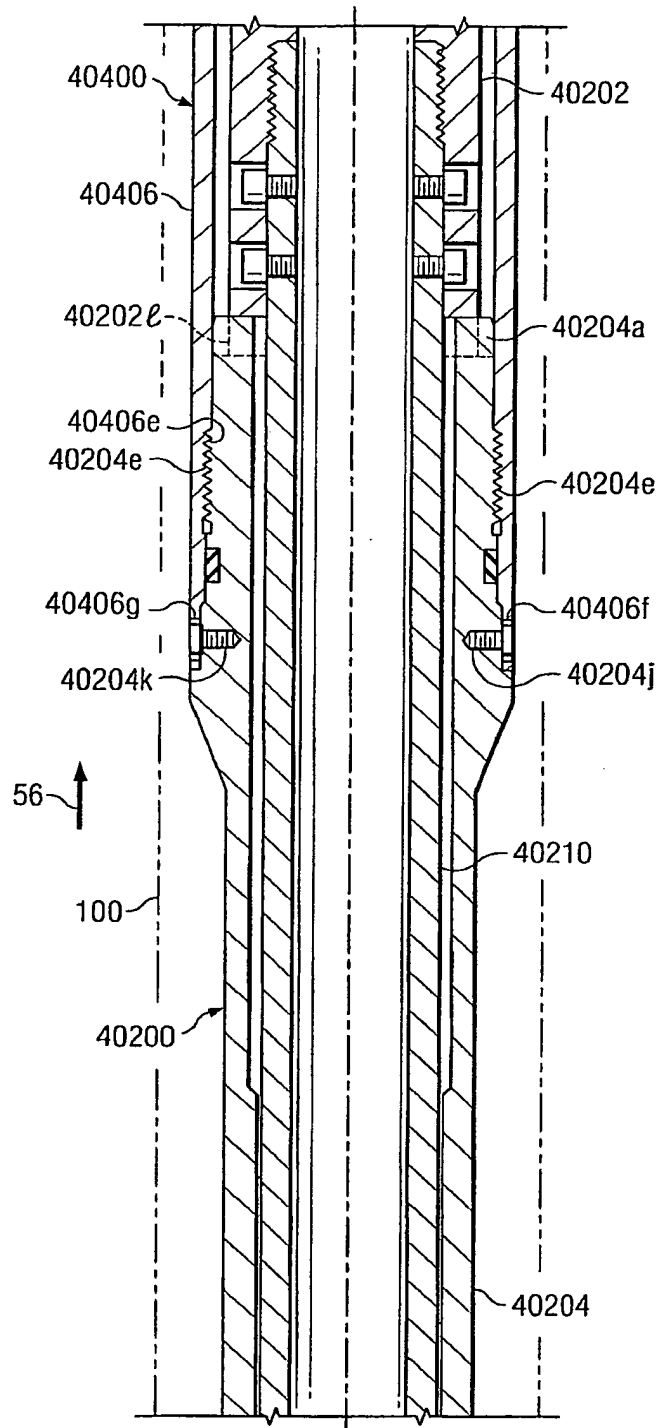


Fig. 39P

*Fig. 39Q*

*Fig. 39R*

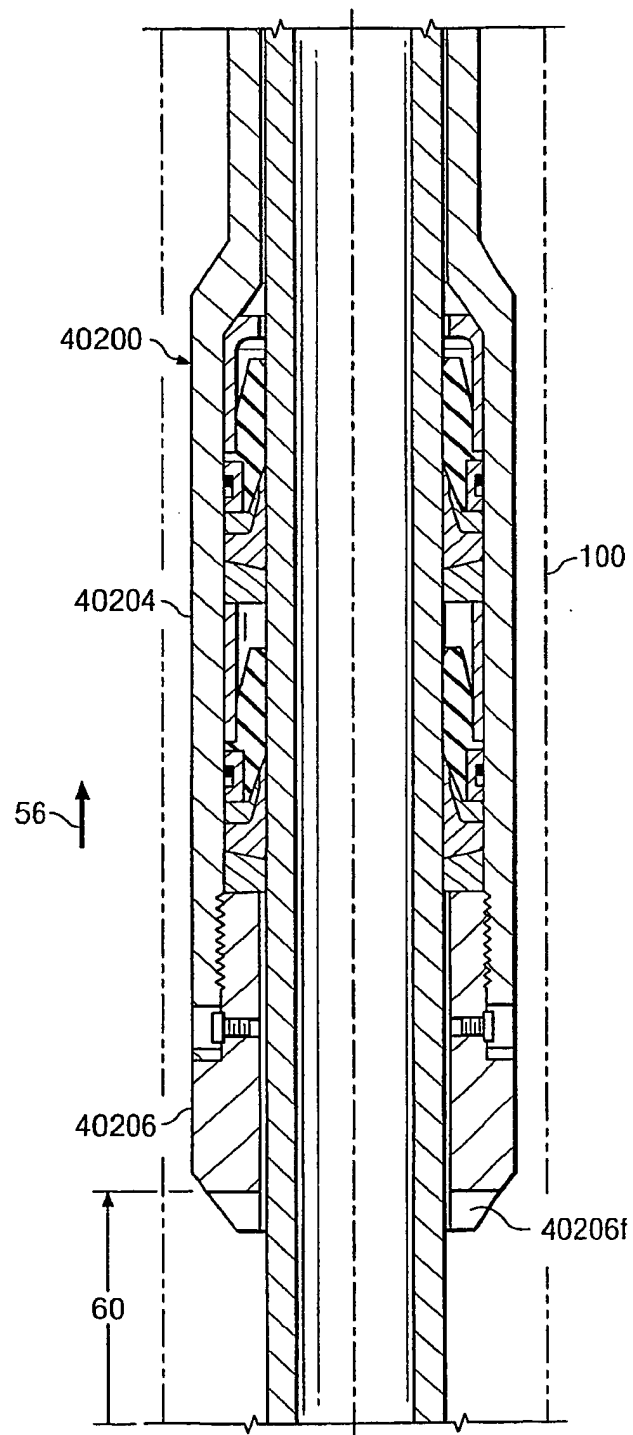
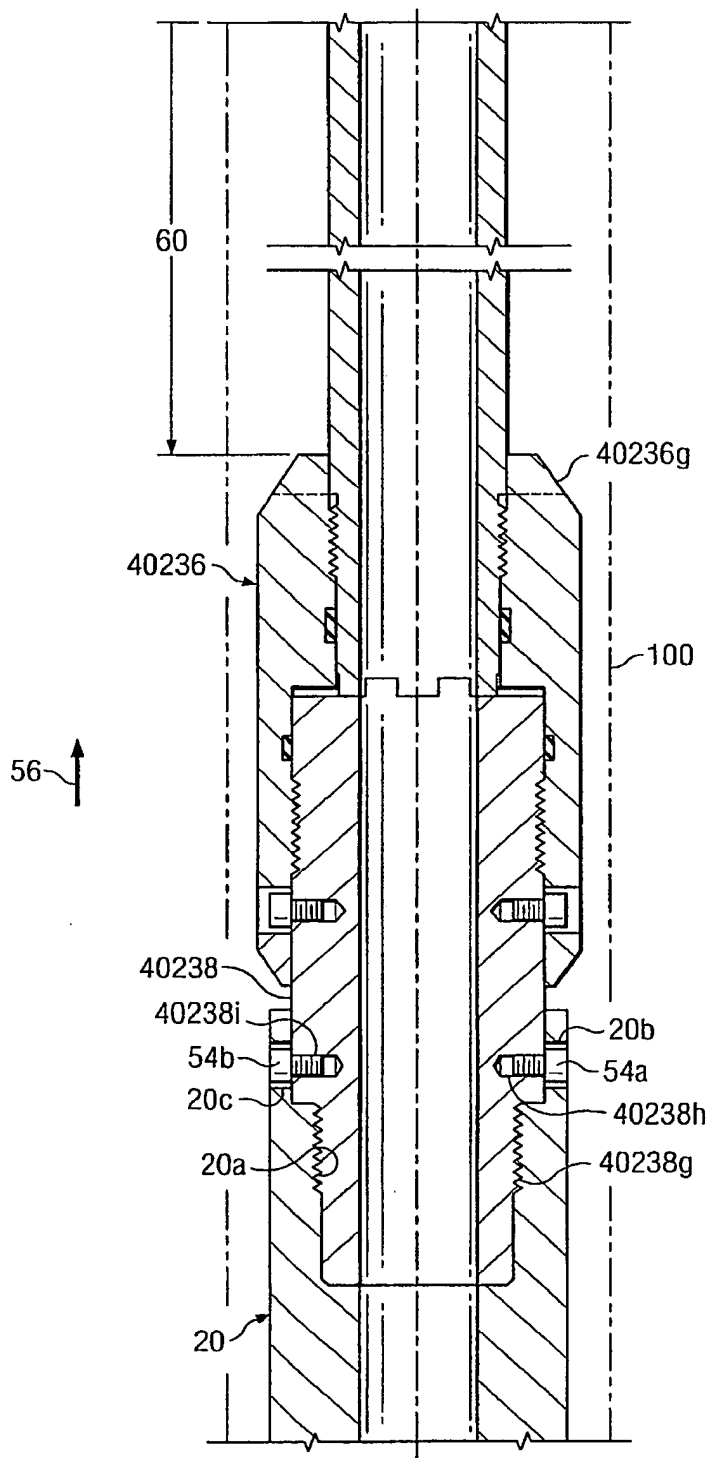
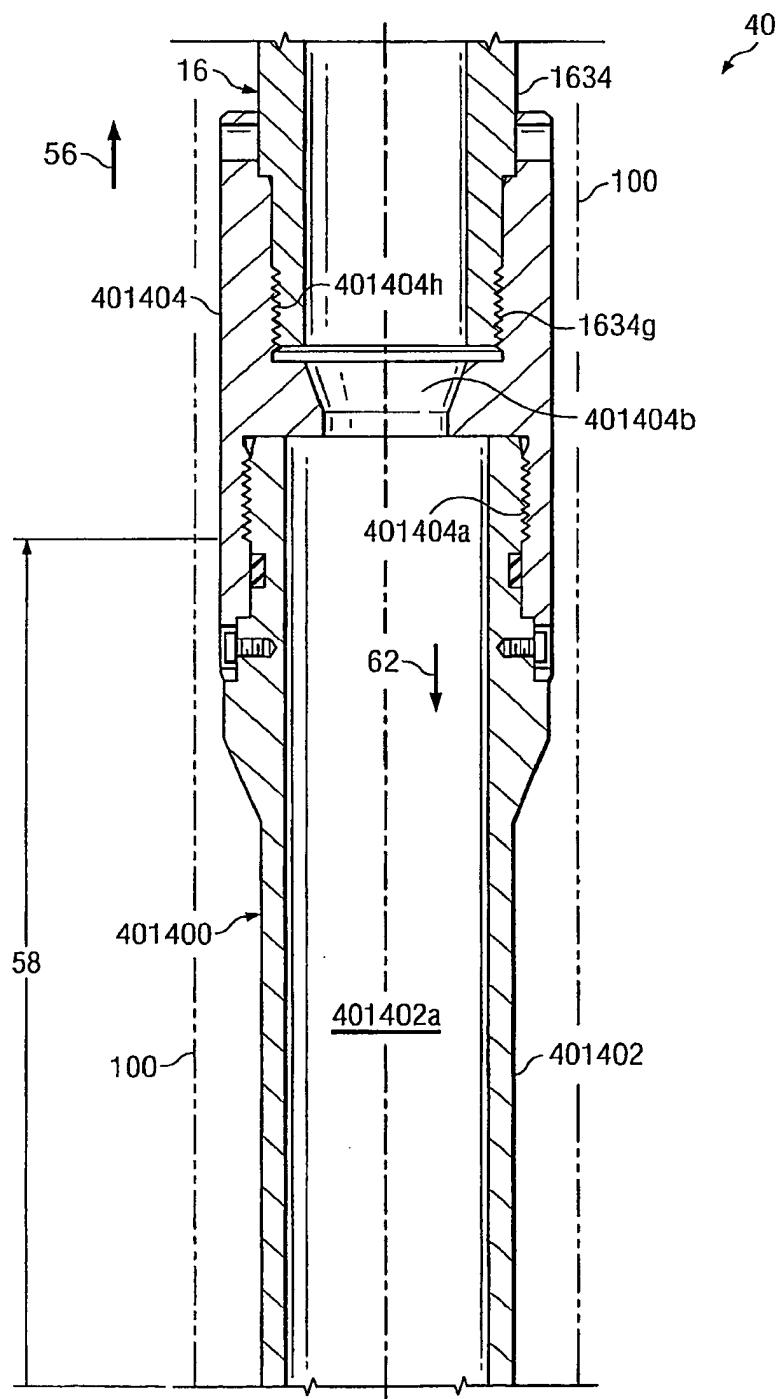
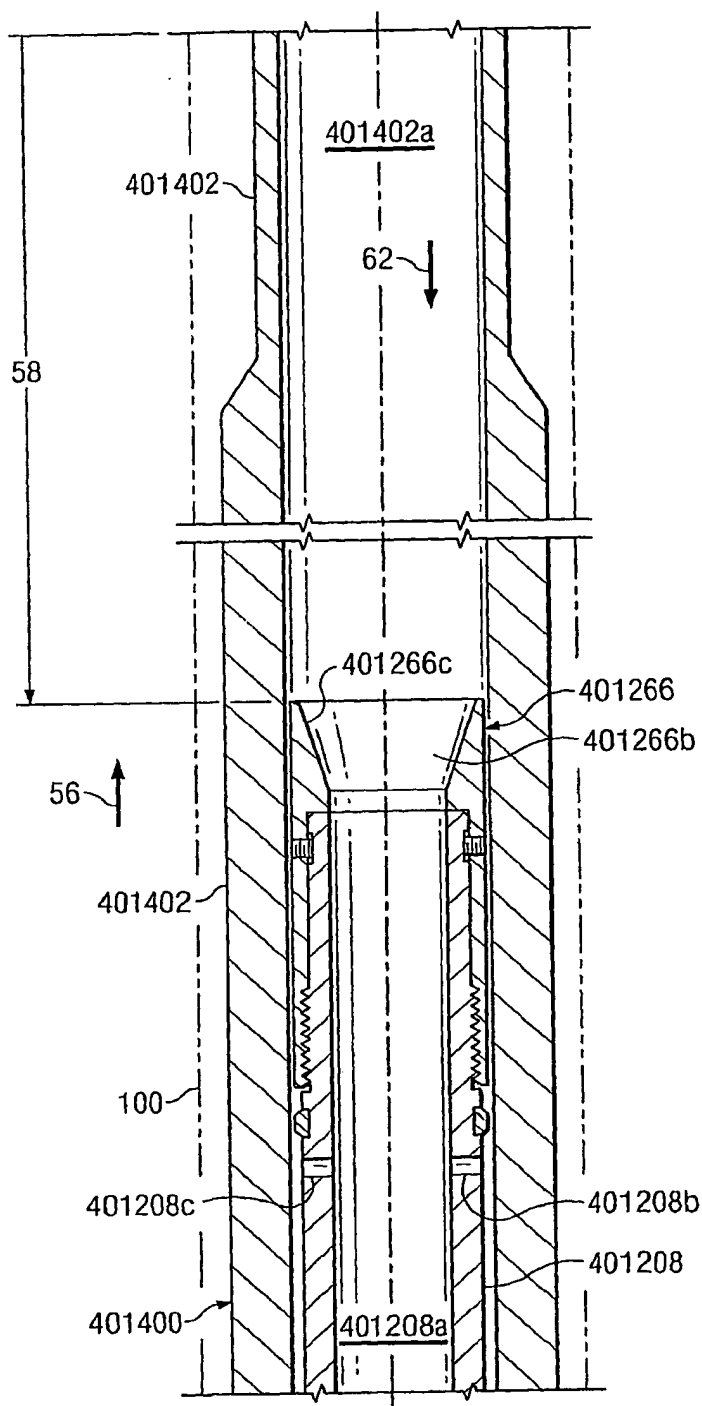


Fig. 39S

*Fig. 39T*

*Fig. 40A*

*Fig. 40B*

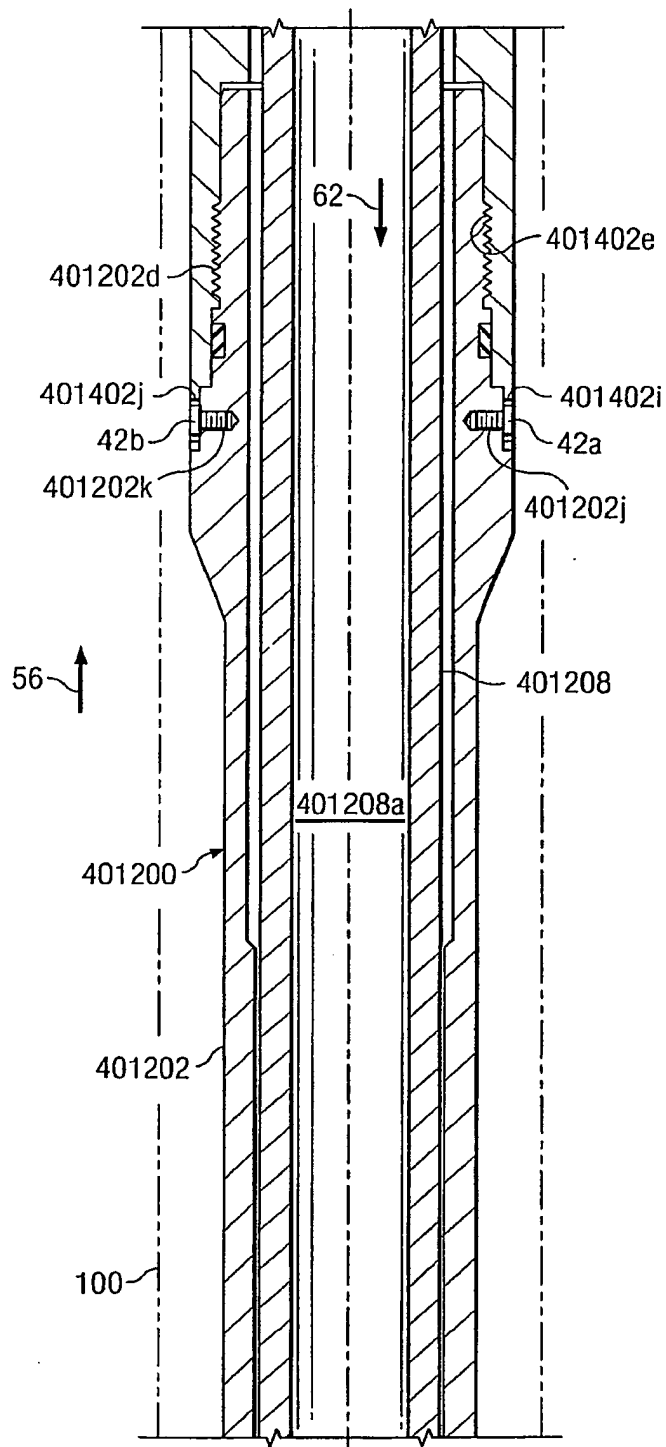
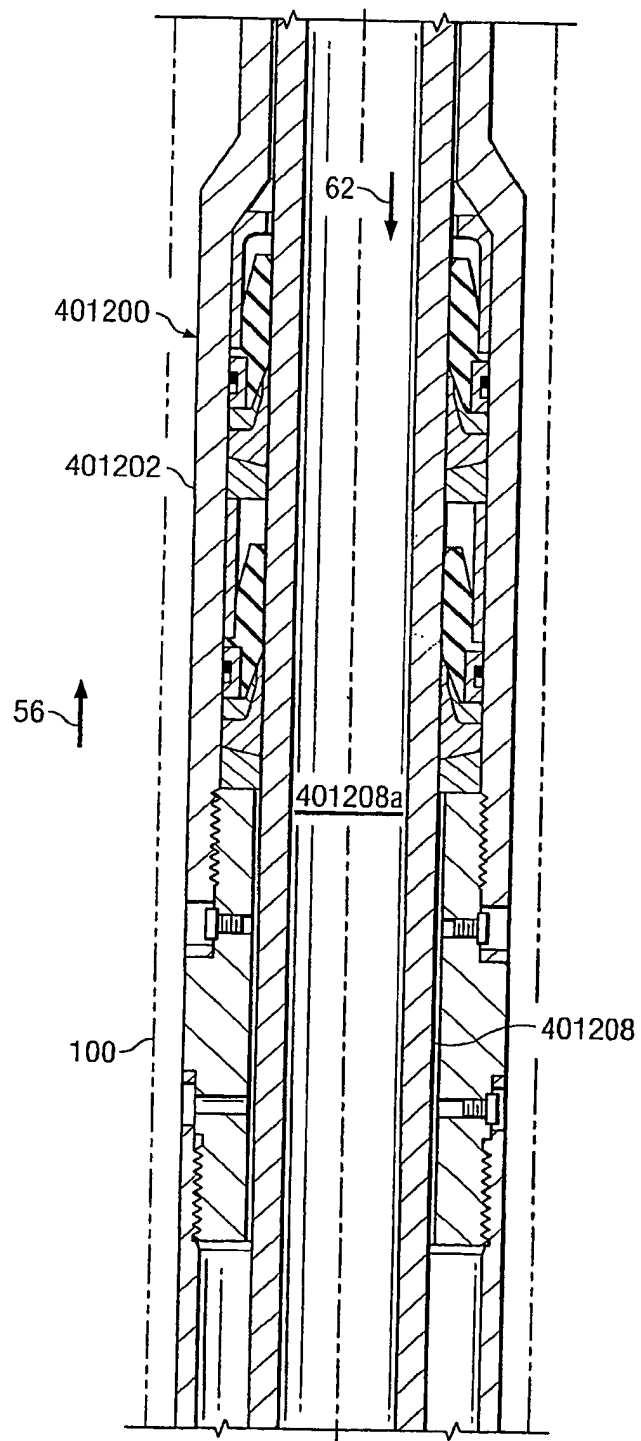


Fig. 40C

*Fig. 40D*

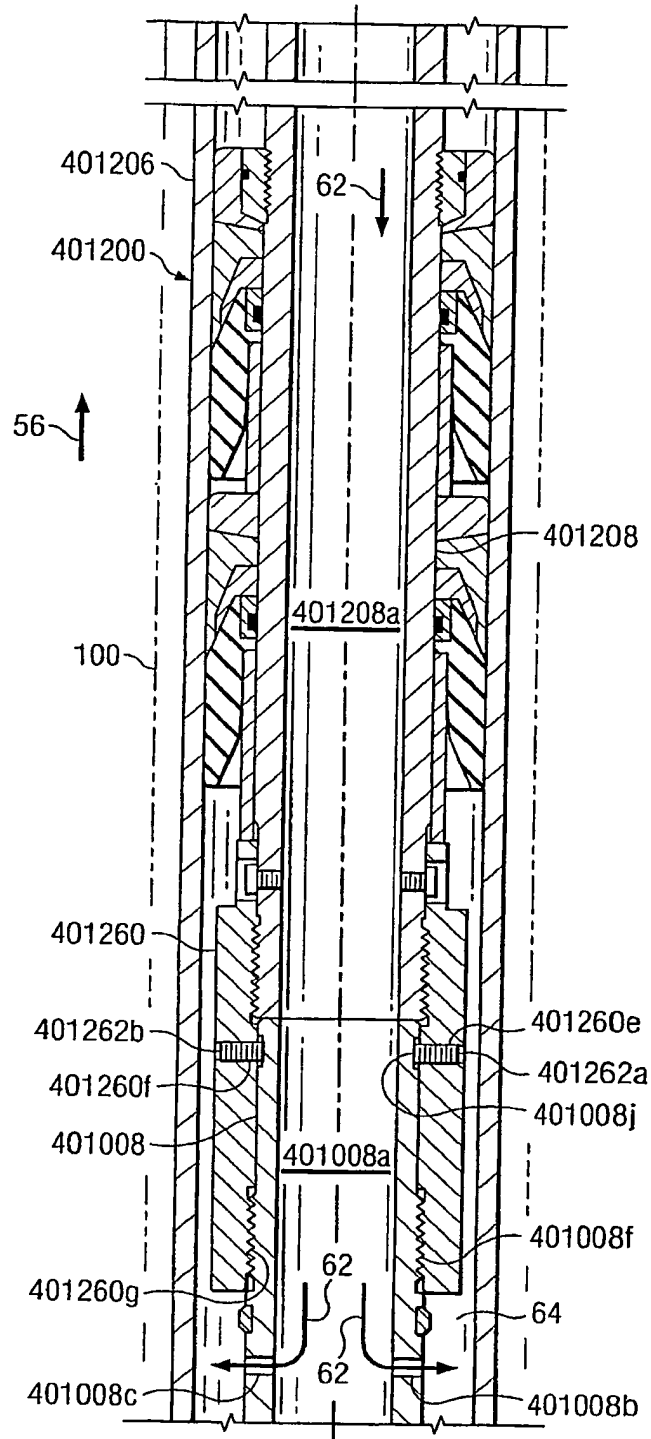
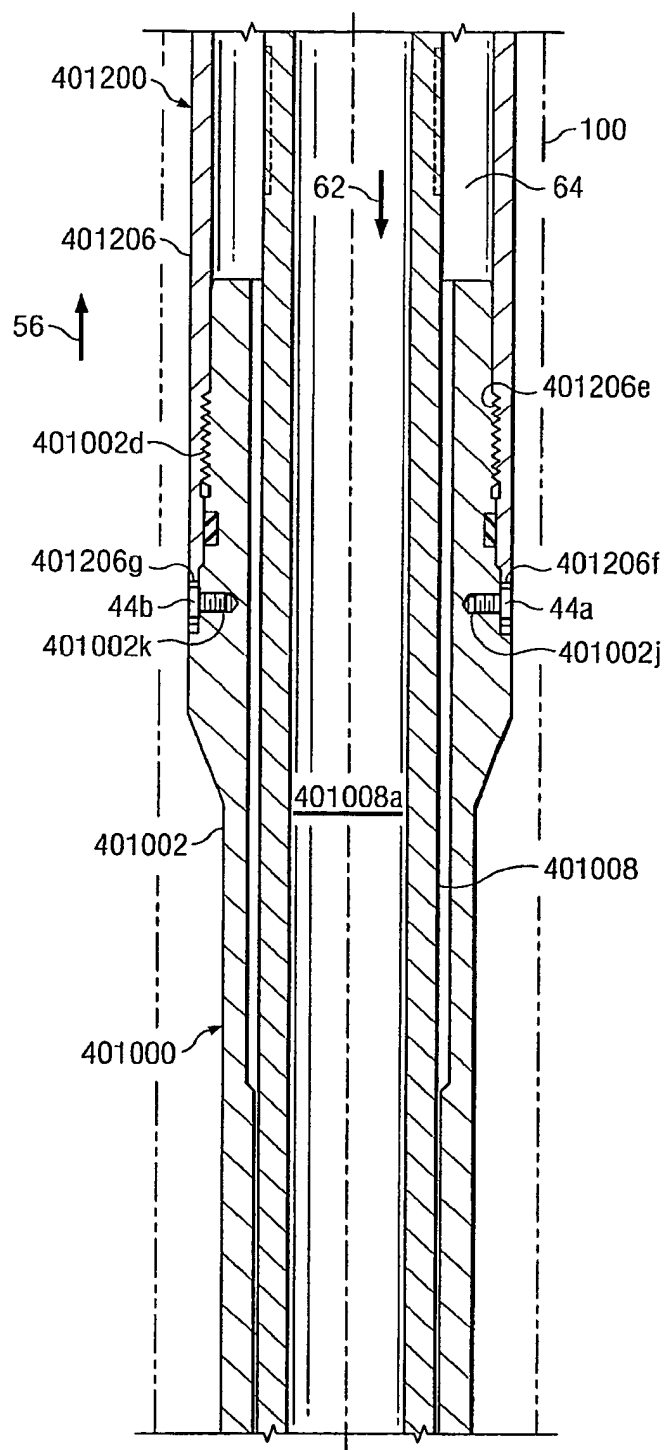


Fig. 40E

*Fig. 40F*

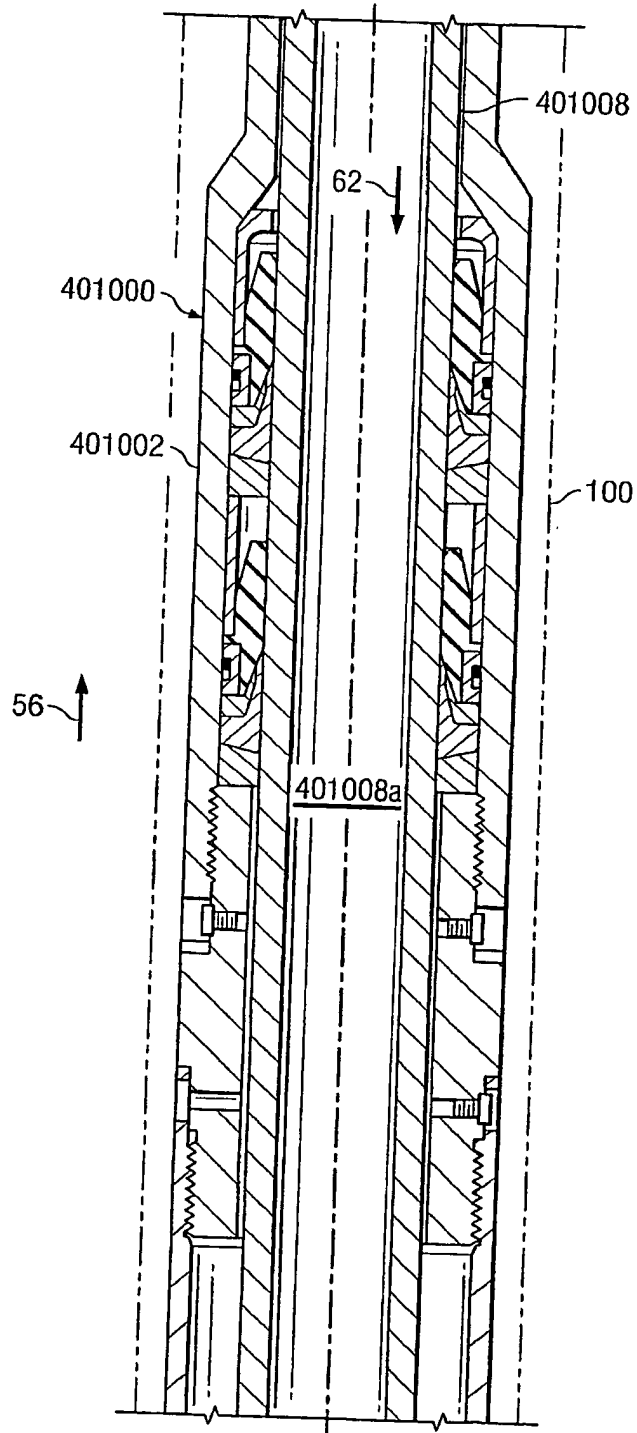
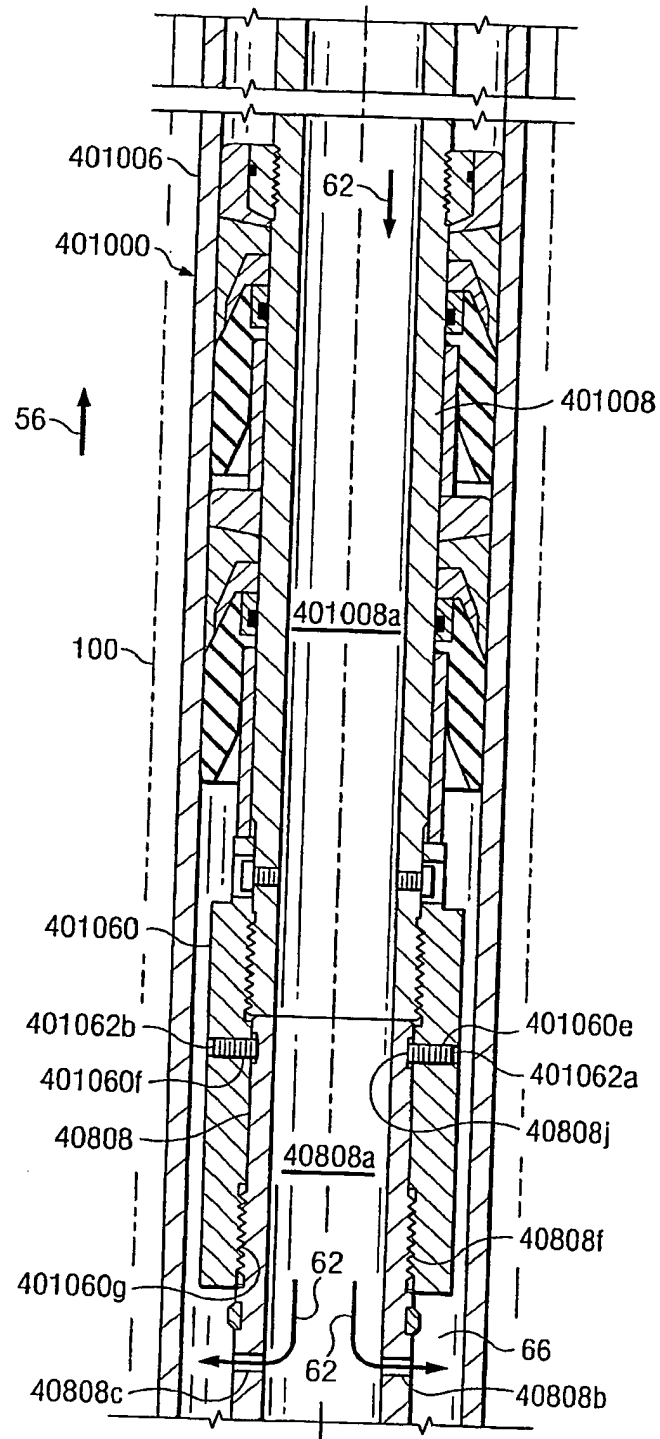
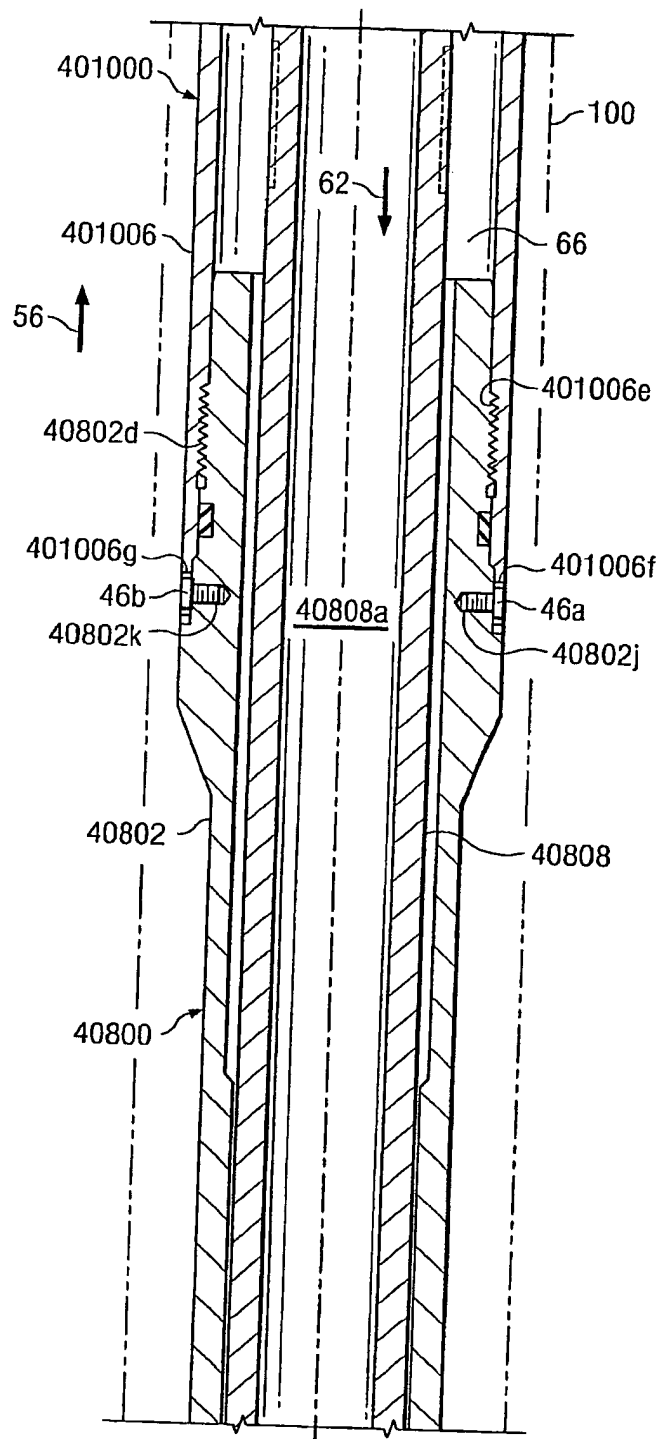
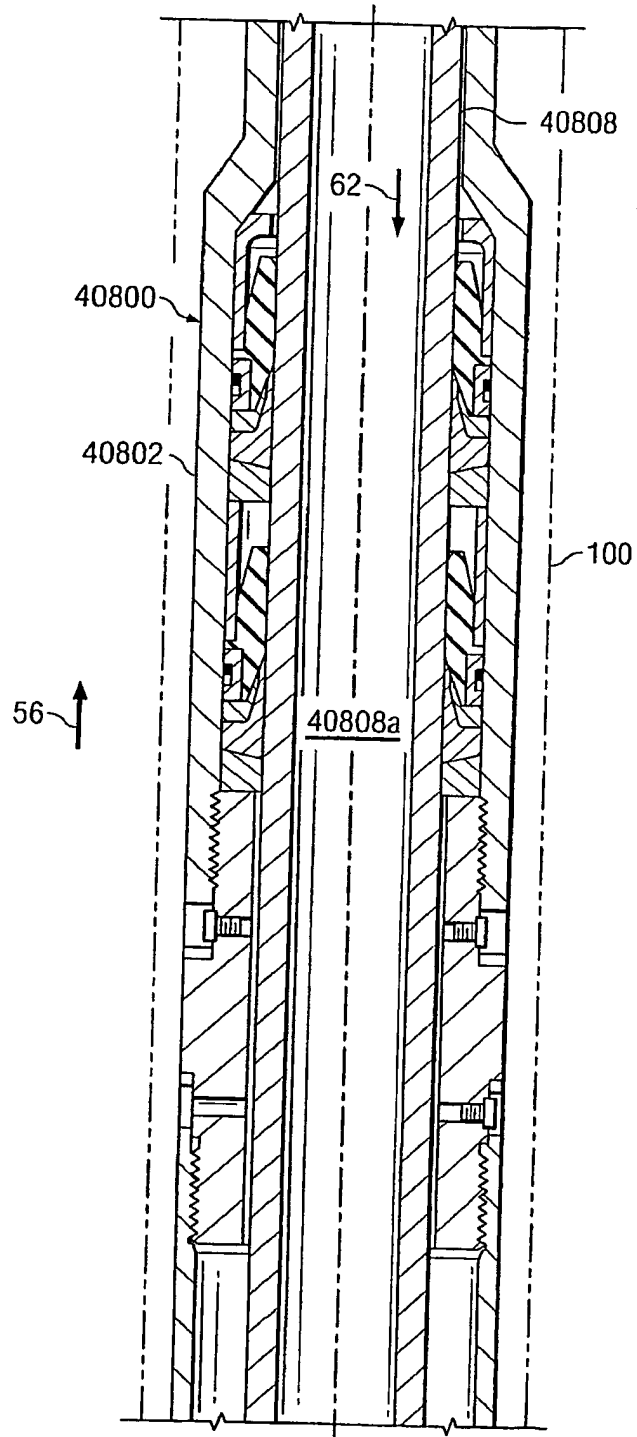
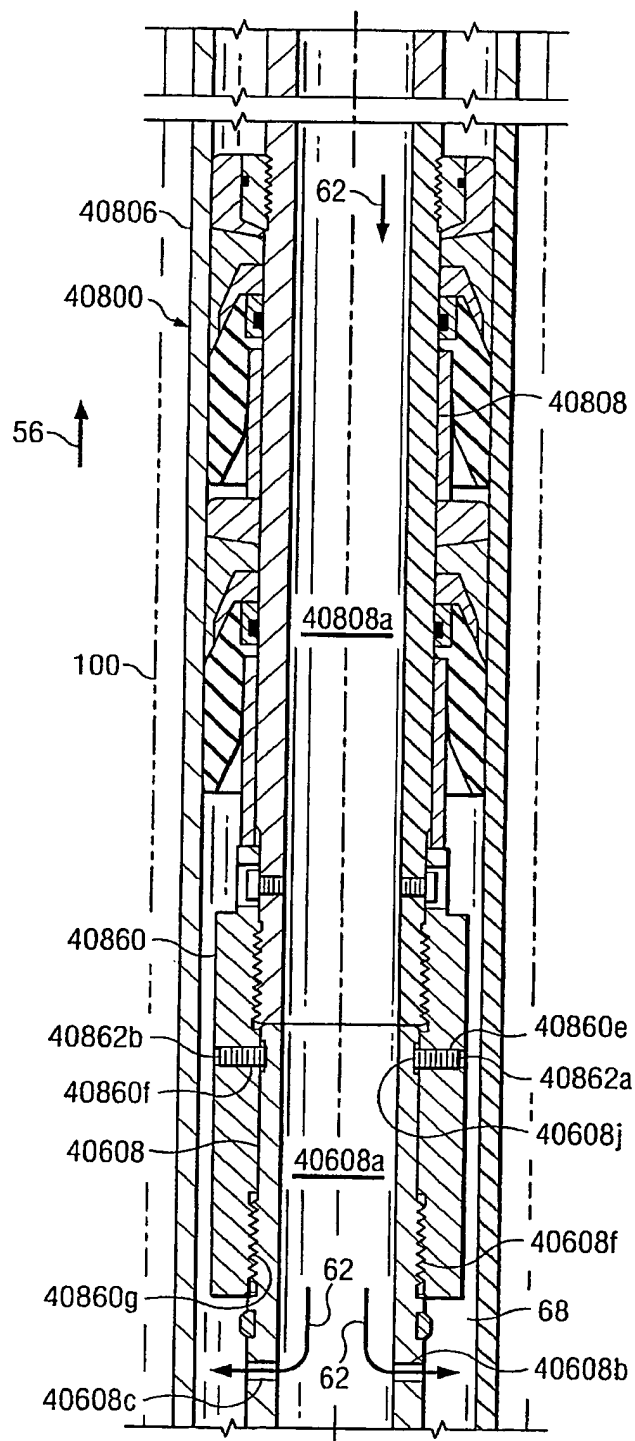


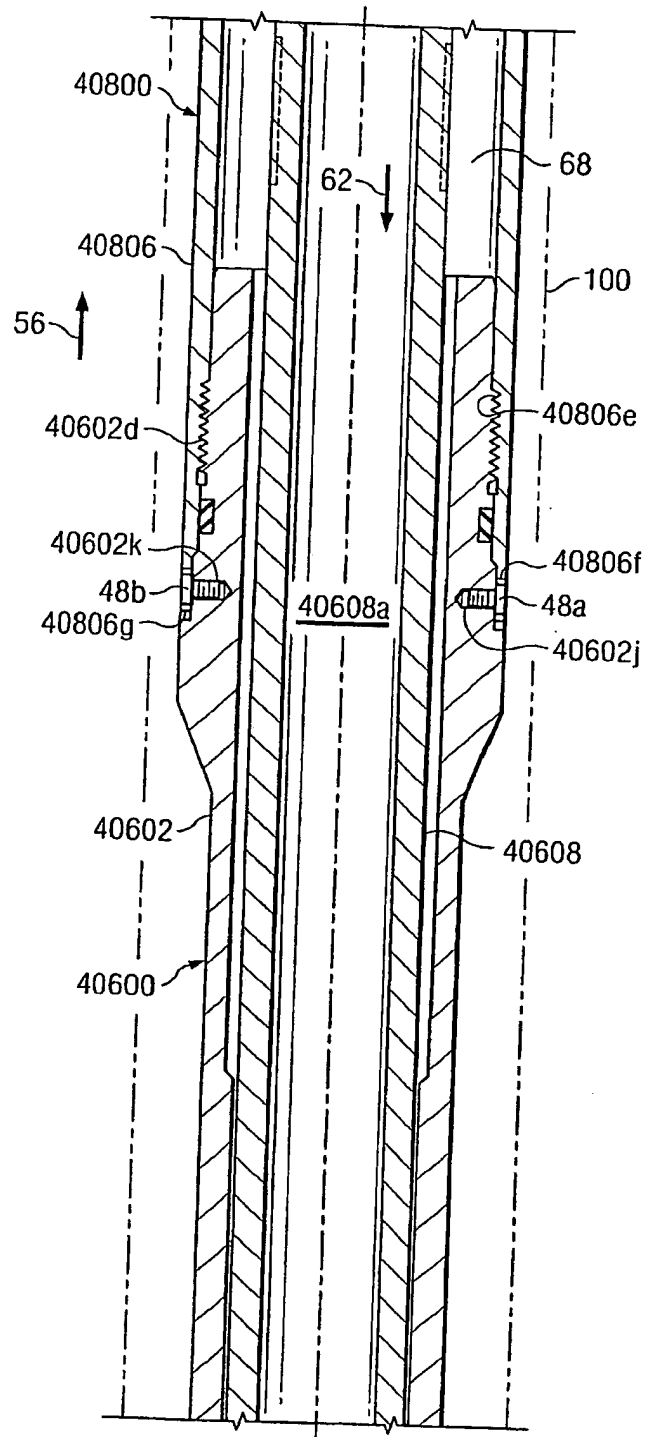
Fig. 40G

*Fig. 40H*

*Fig. 40I*

*Fig. 40J*

*Fig. 40K*

*Fig. 40L*

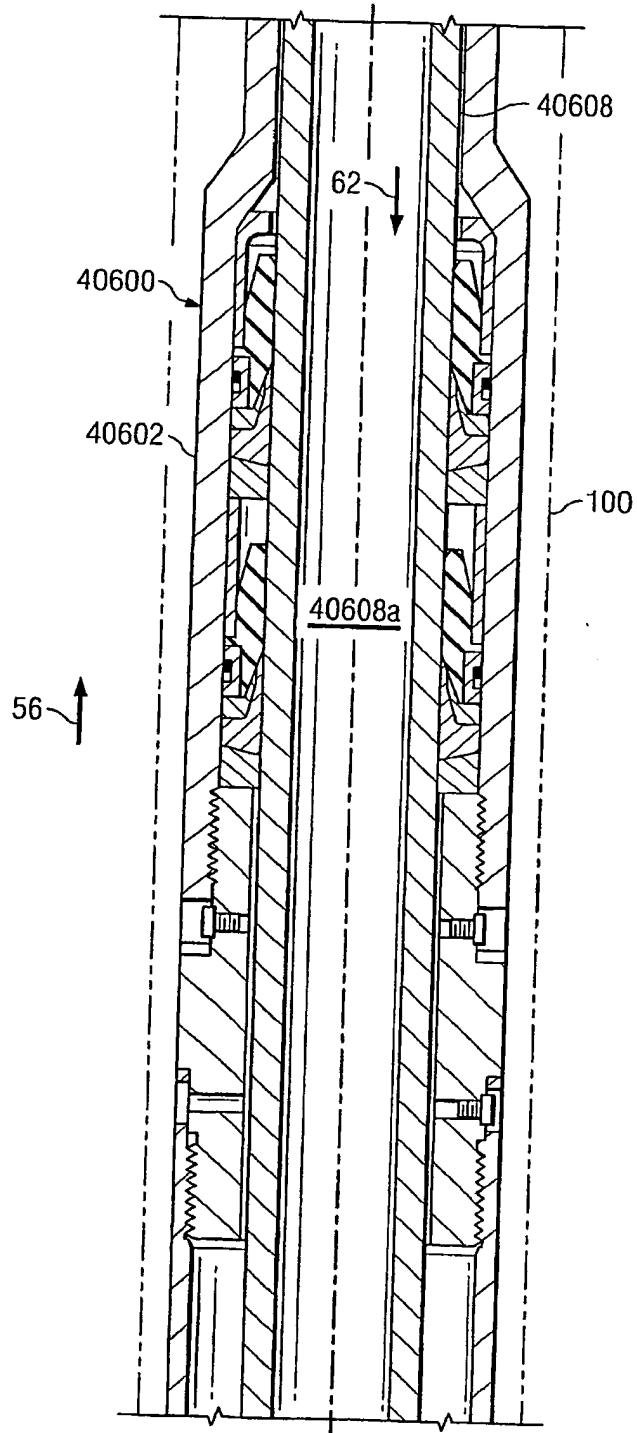
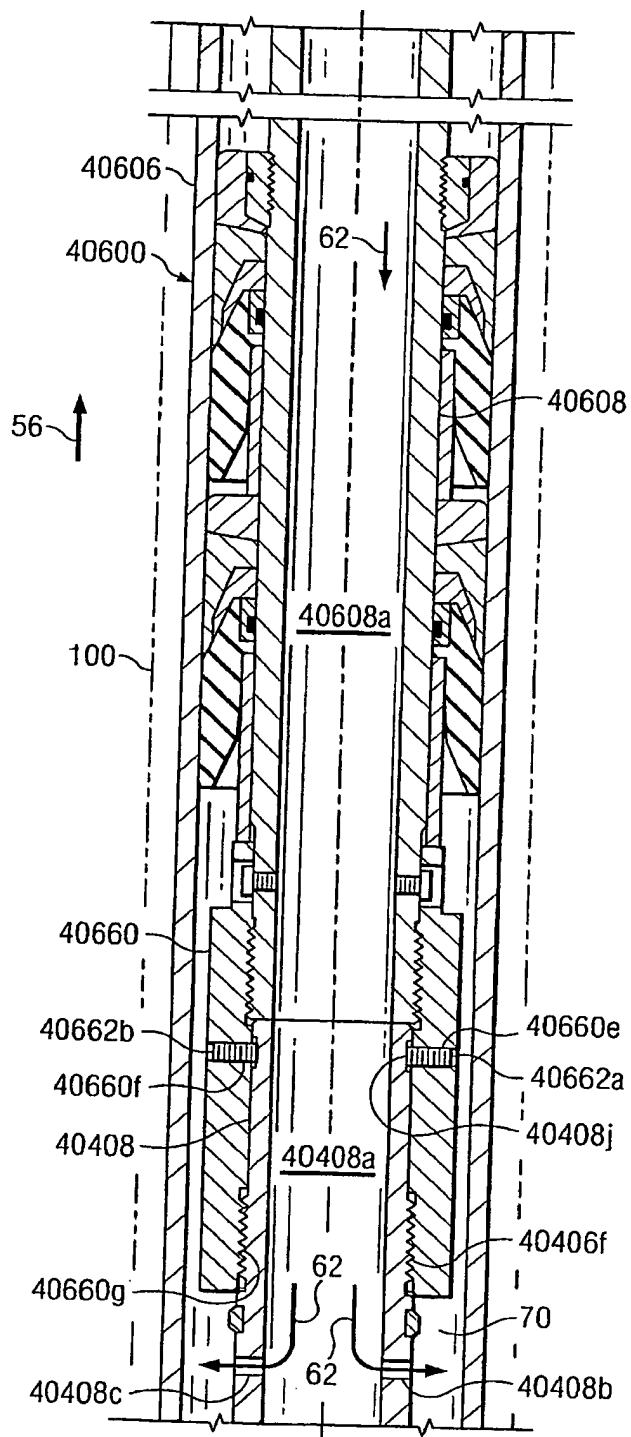
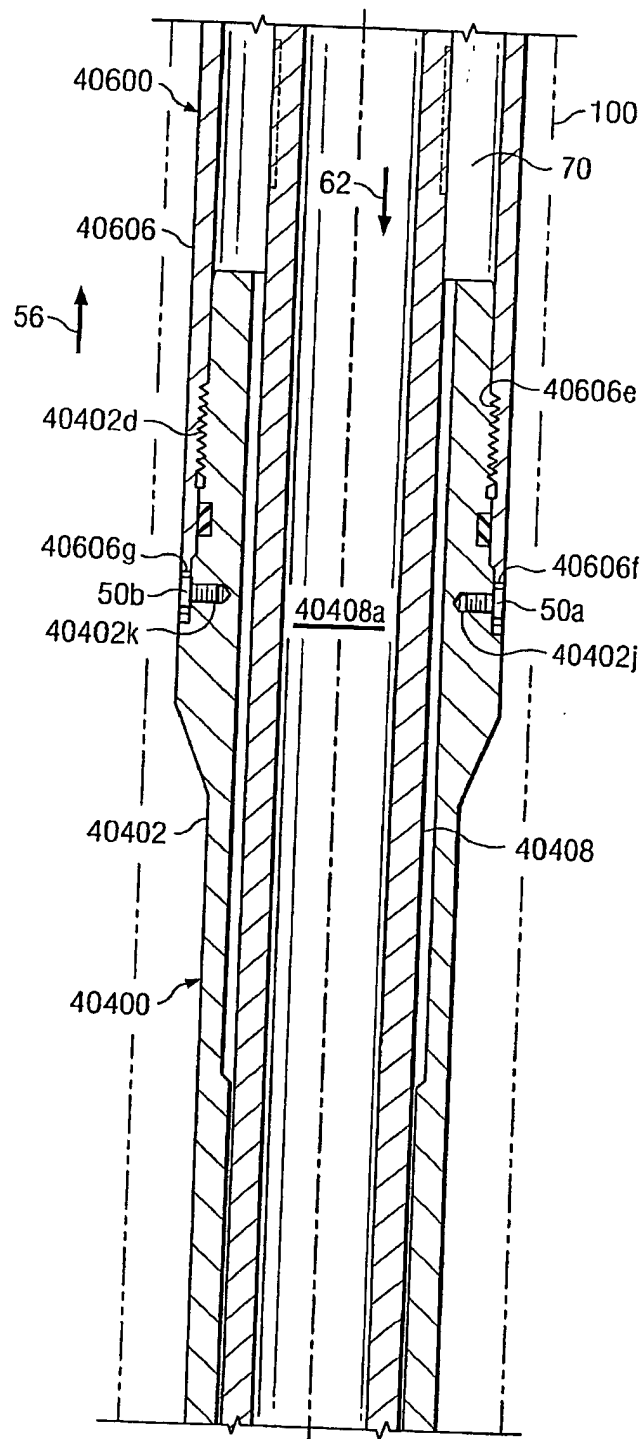


Fig. 40M

*Fig. 40N*

*Fig. 400*

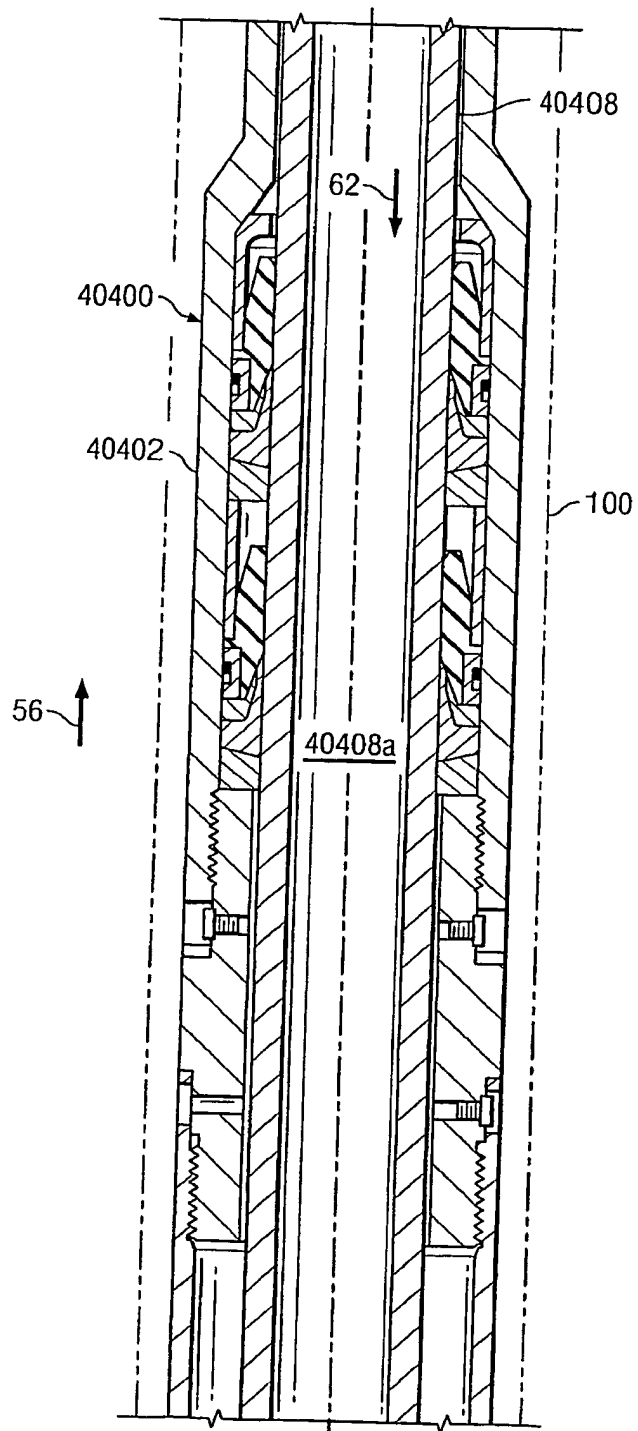
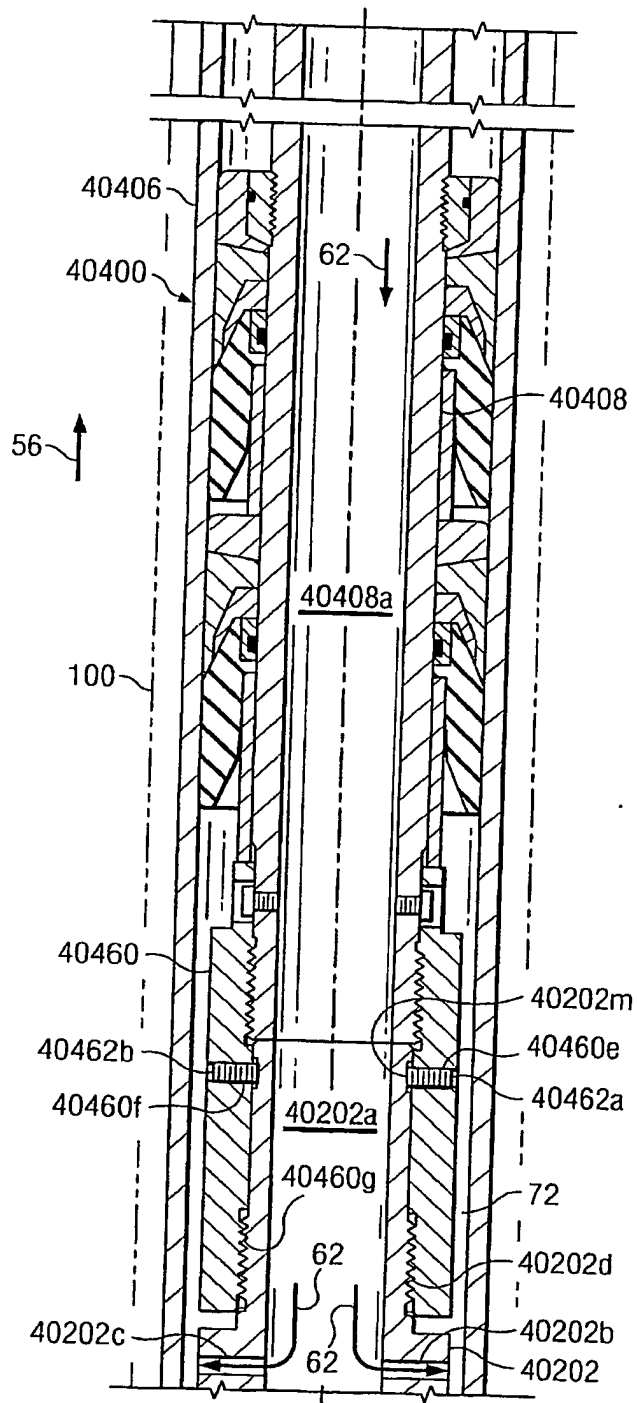
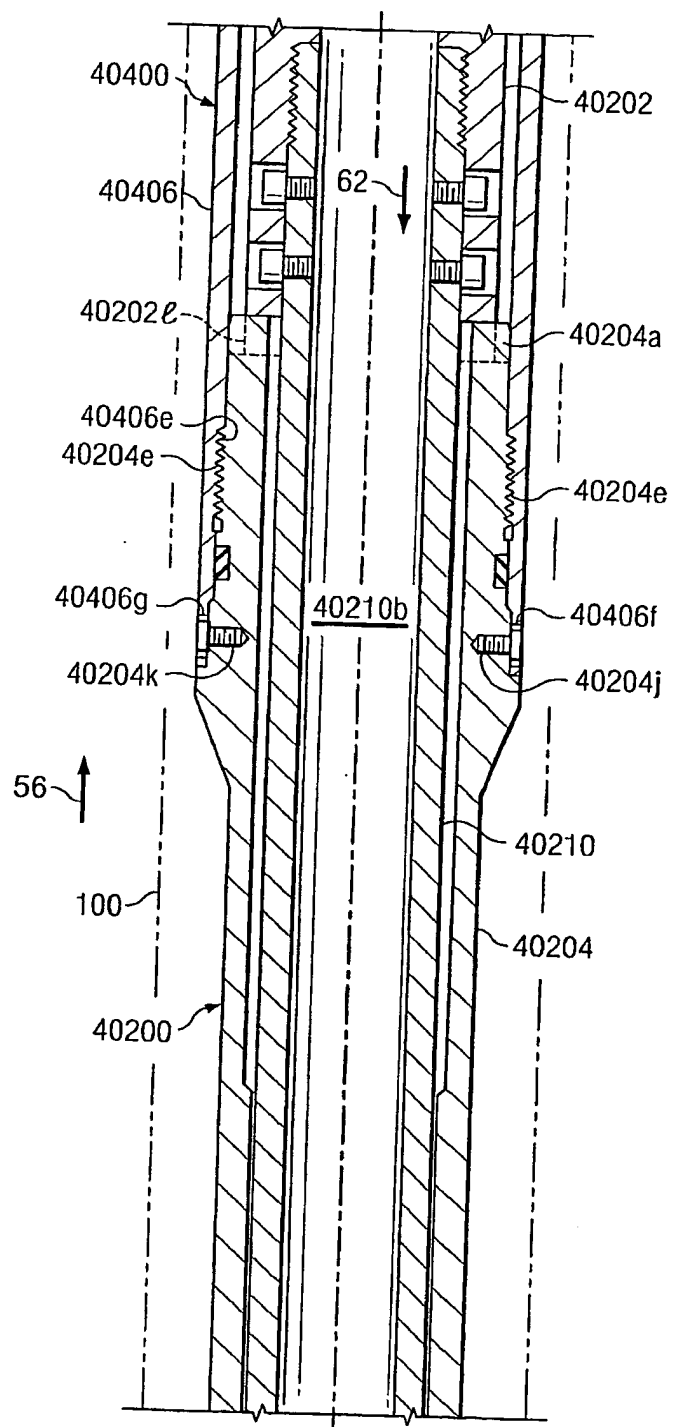
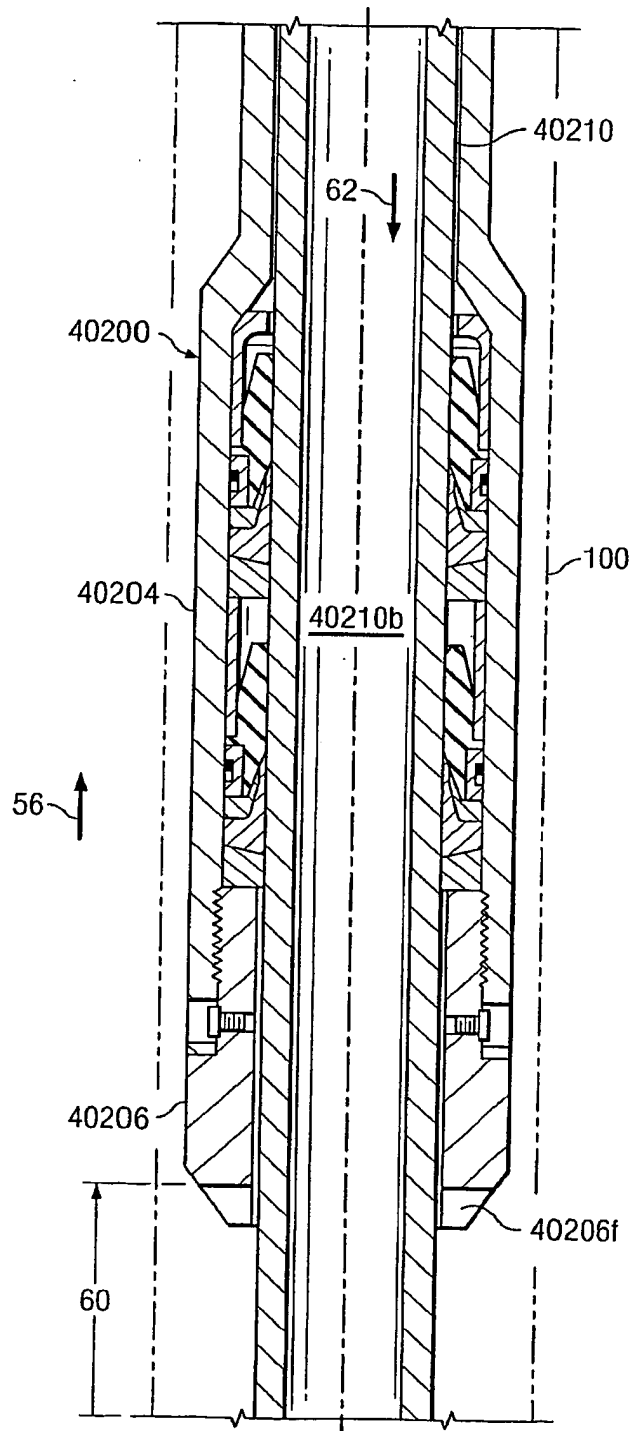
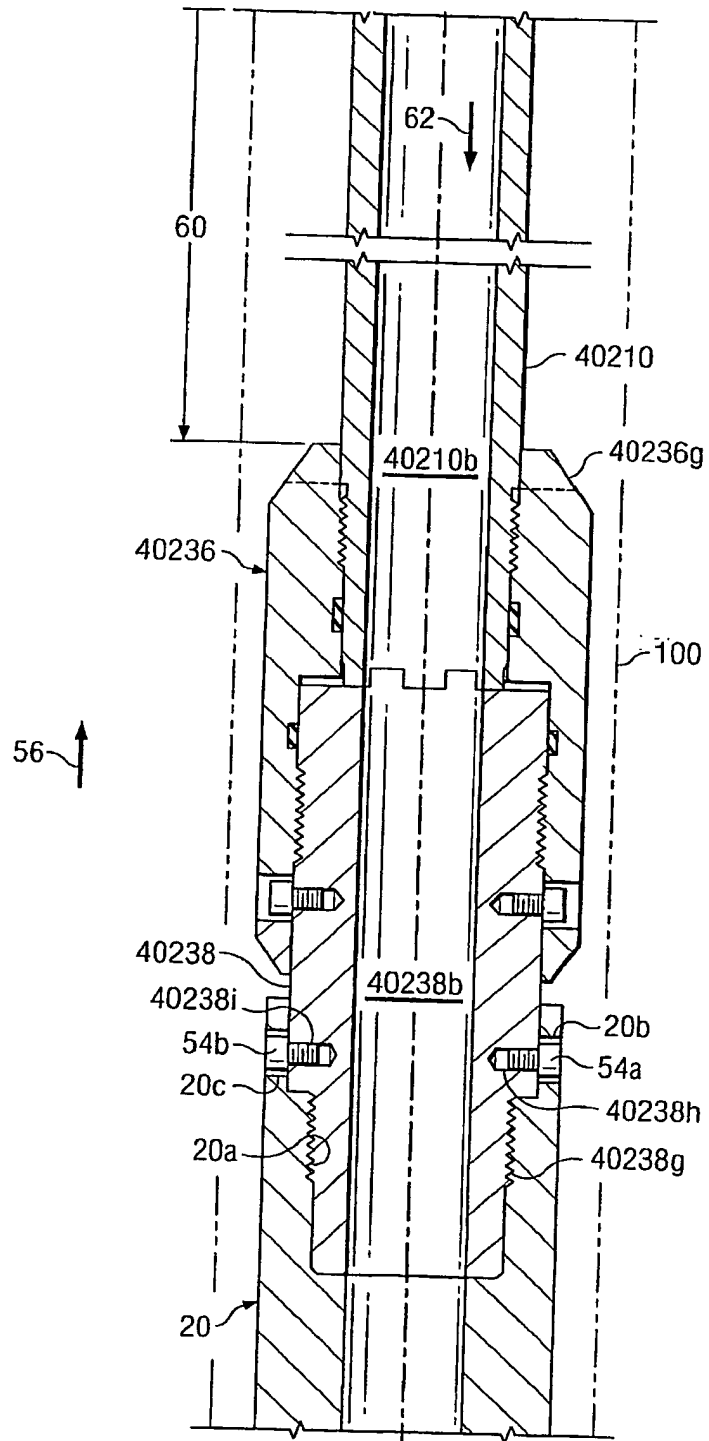


Fig. 40P

*Fig. 40Q*

*Fig. 40R*

*Fig. 40S*

*Fig. 40T*

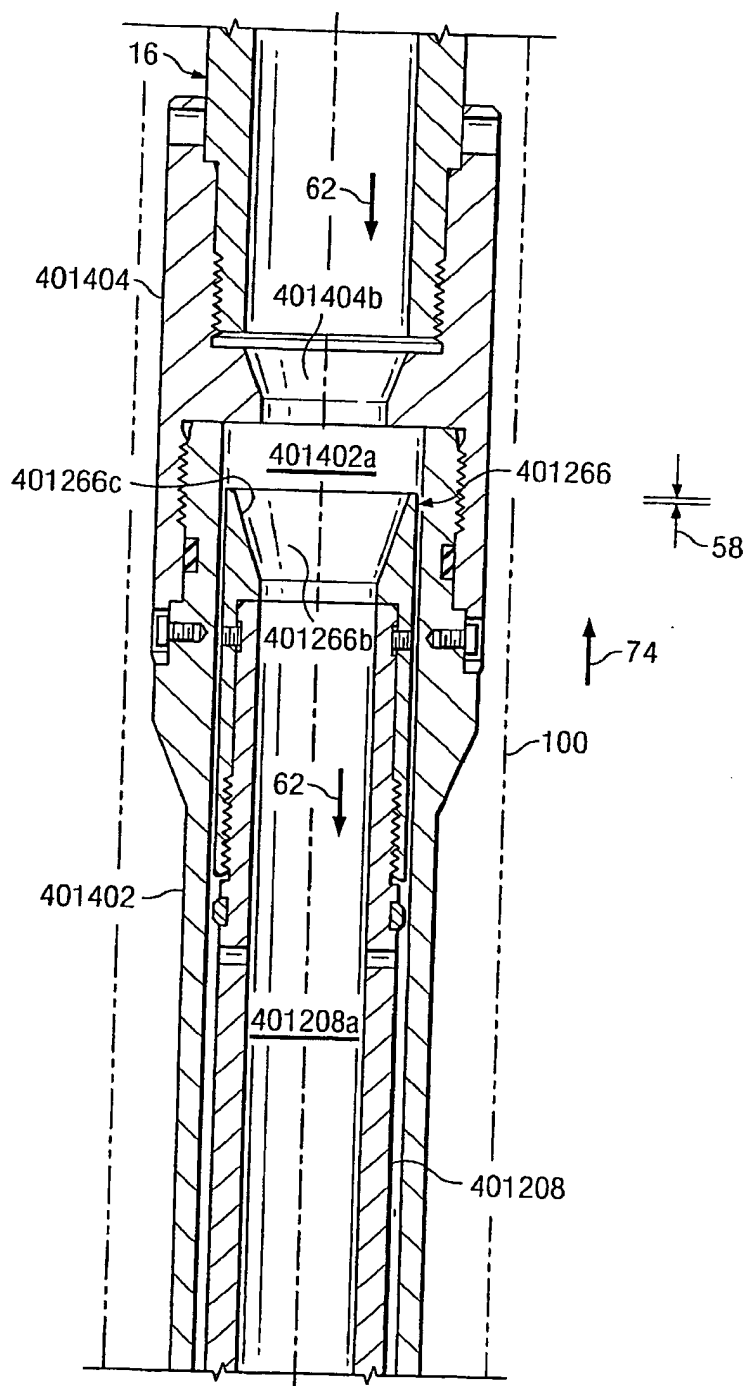


Fig. 41A

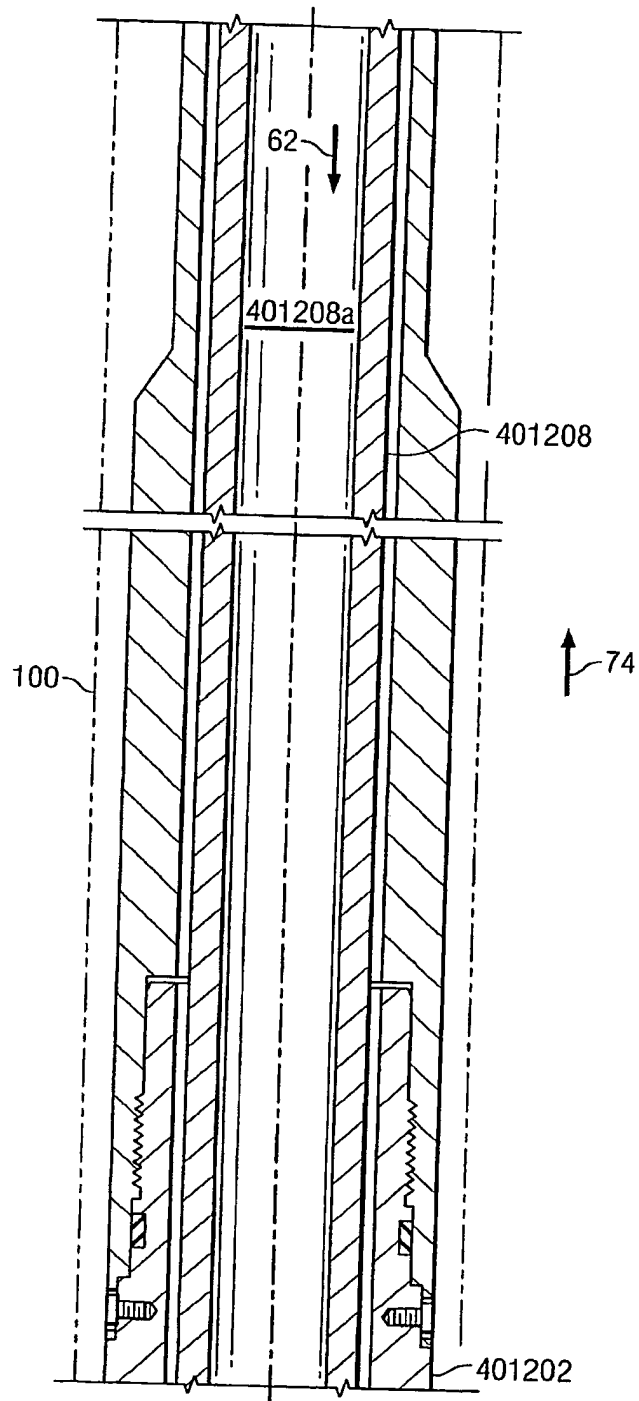
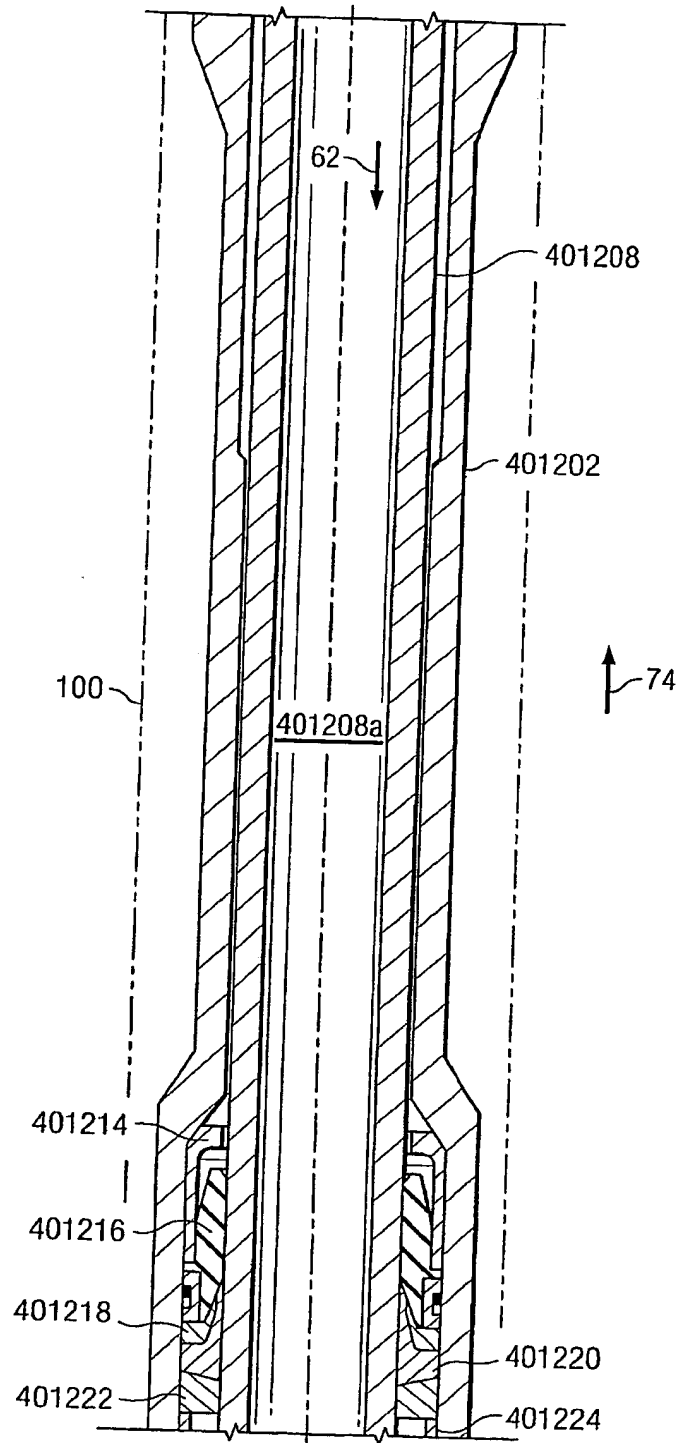
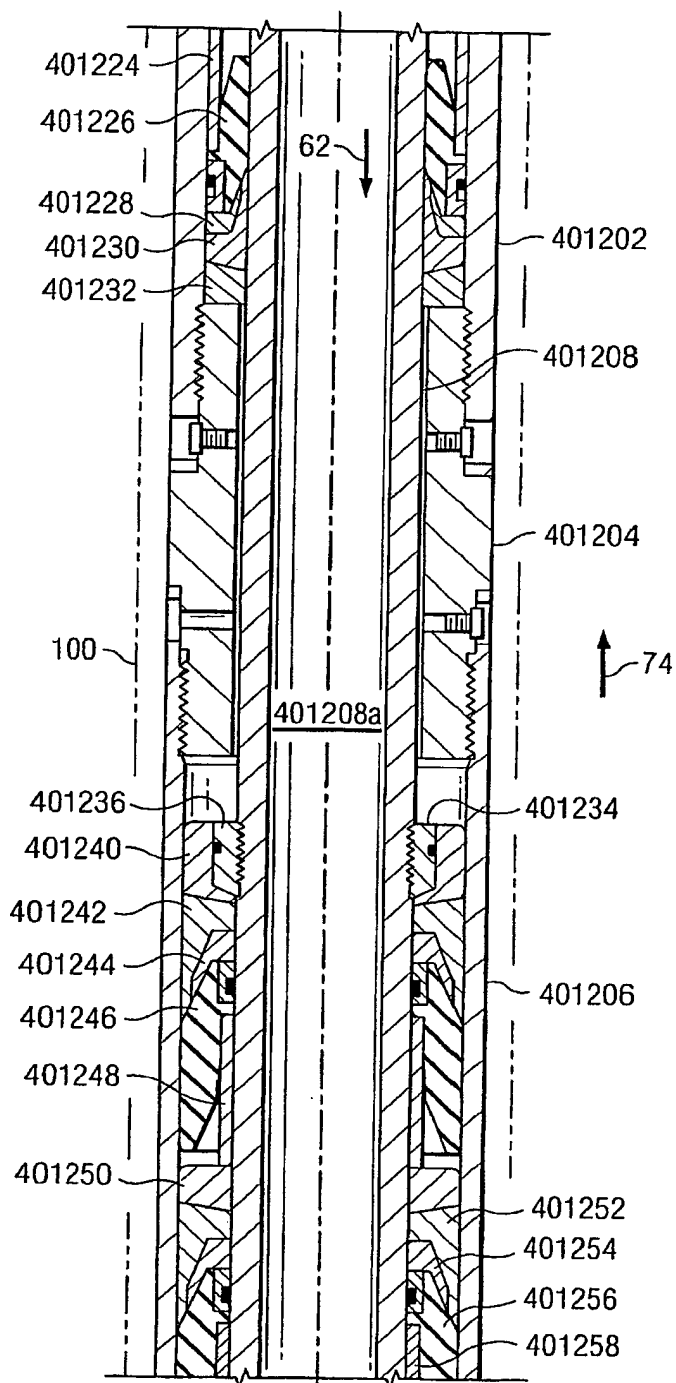


Fig. 41B

*Fig. 41C*

*Fig. 41D*

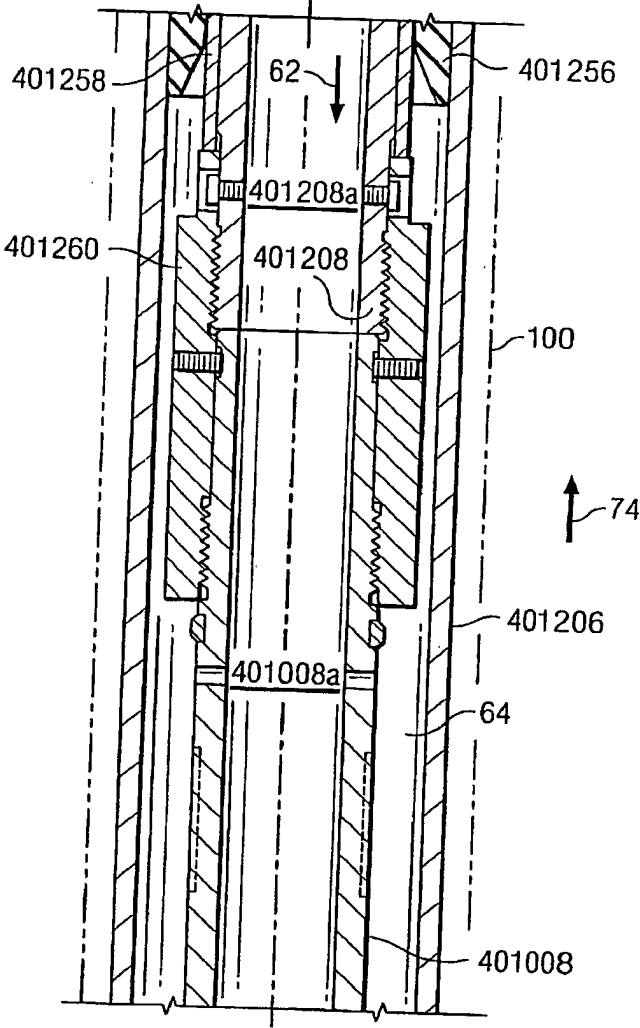
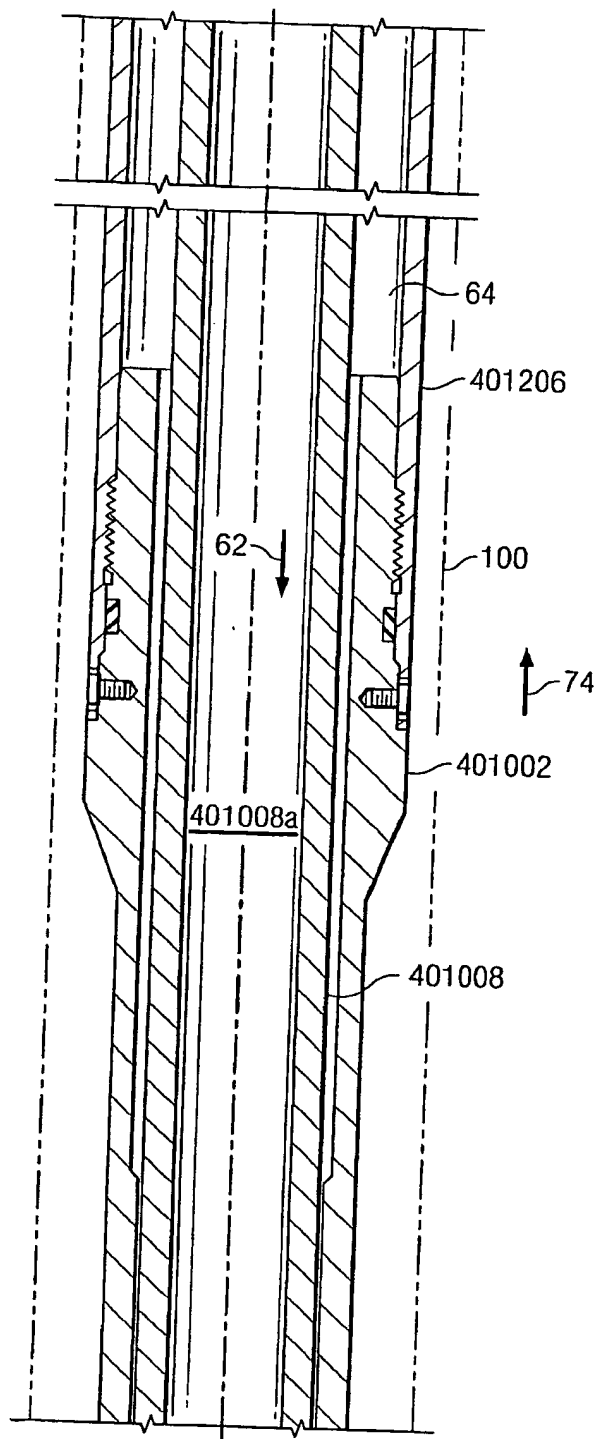
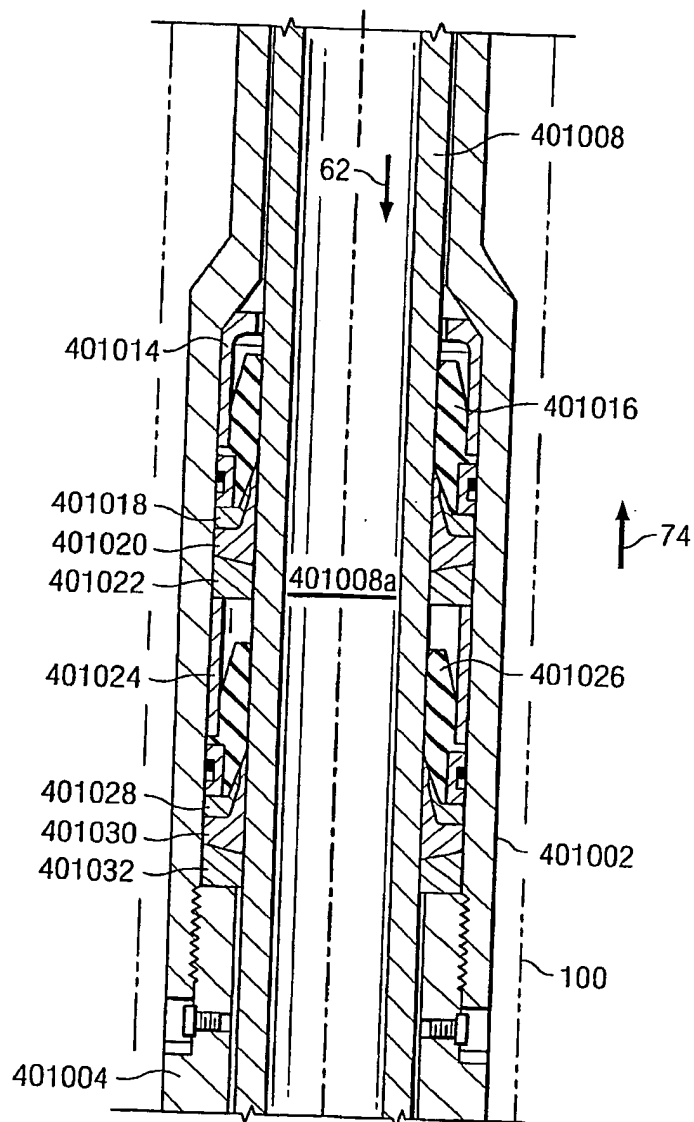
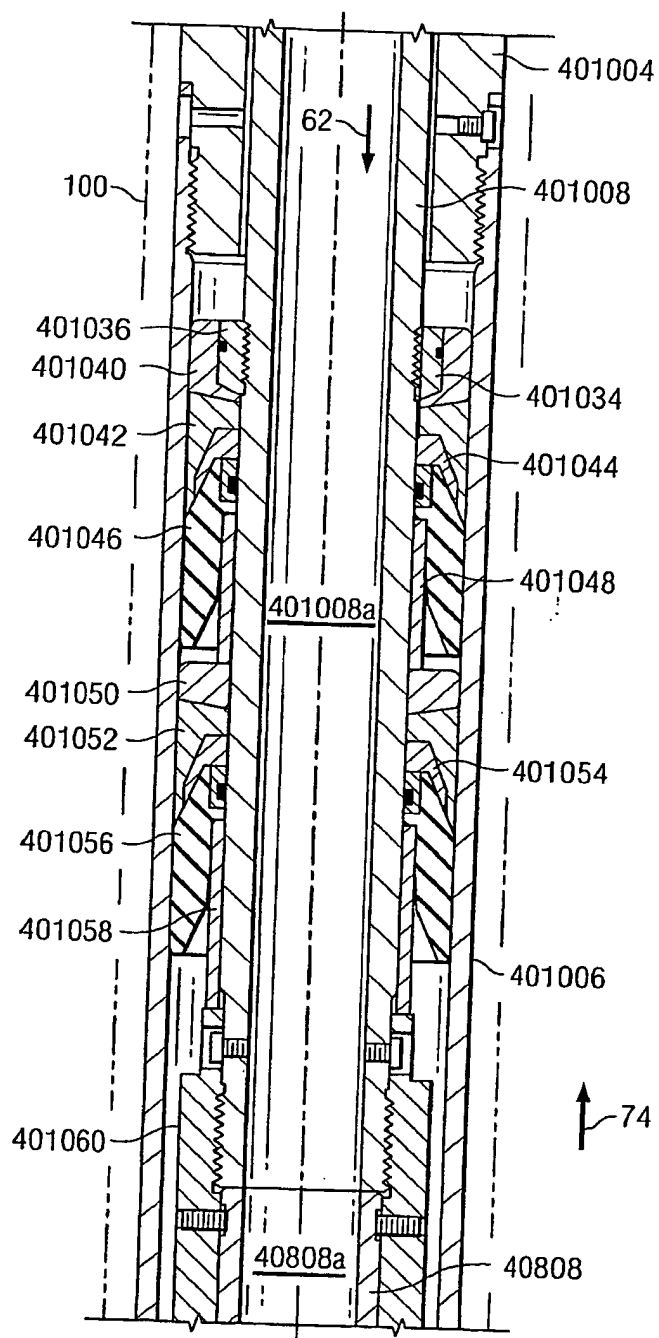


Fig. 41E

*Fig. 41F*

*Fig. 41G*

*Fig. 41H*

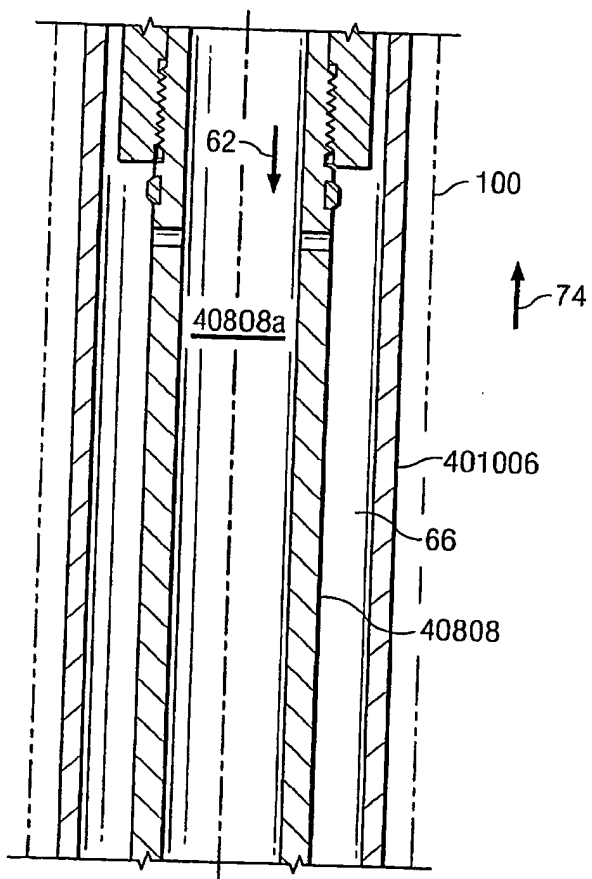
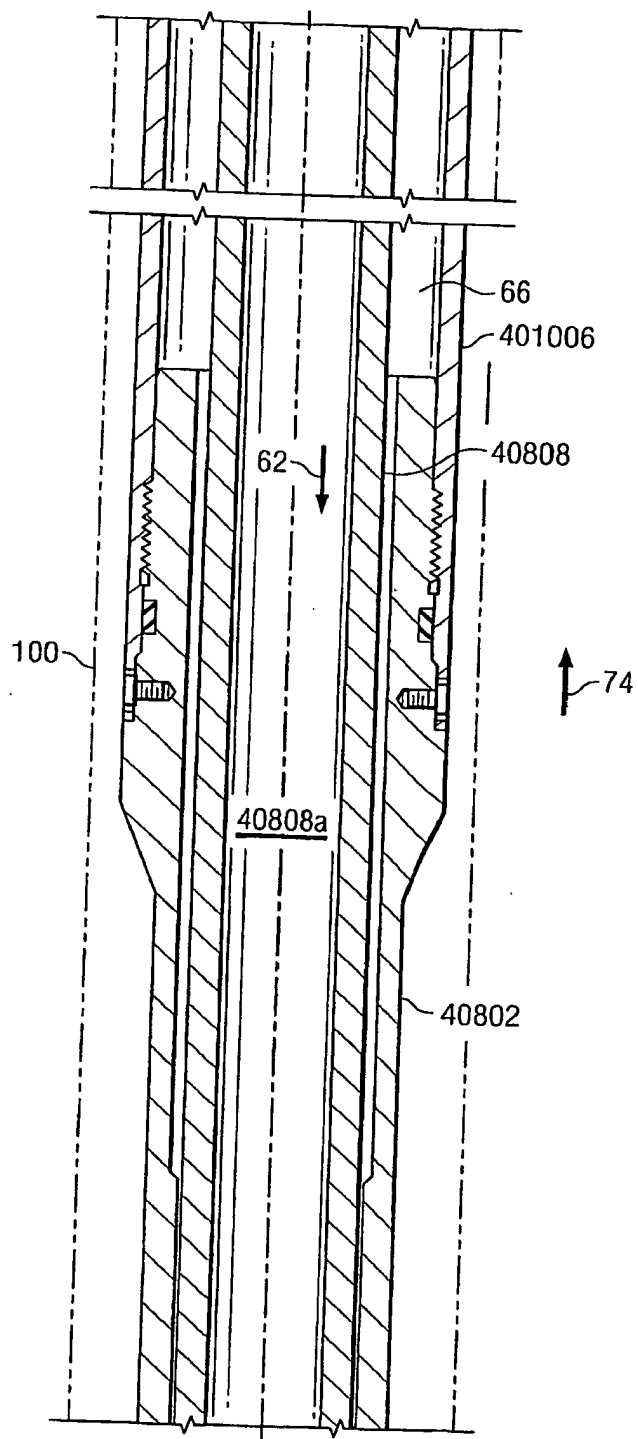
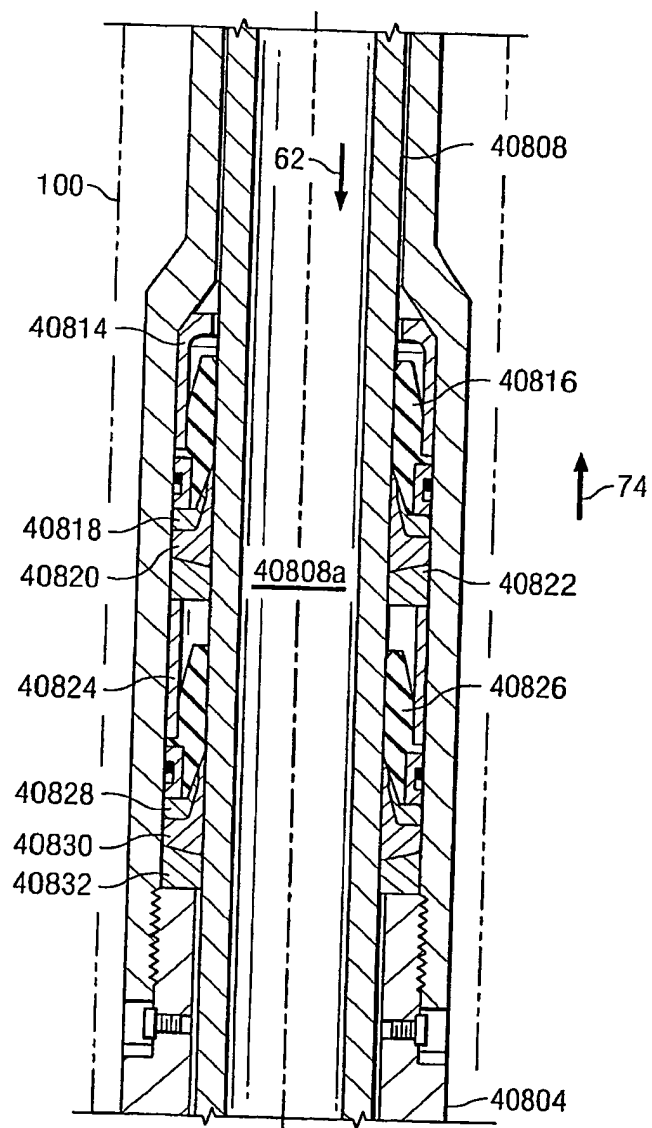
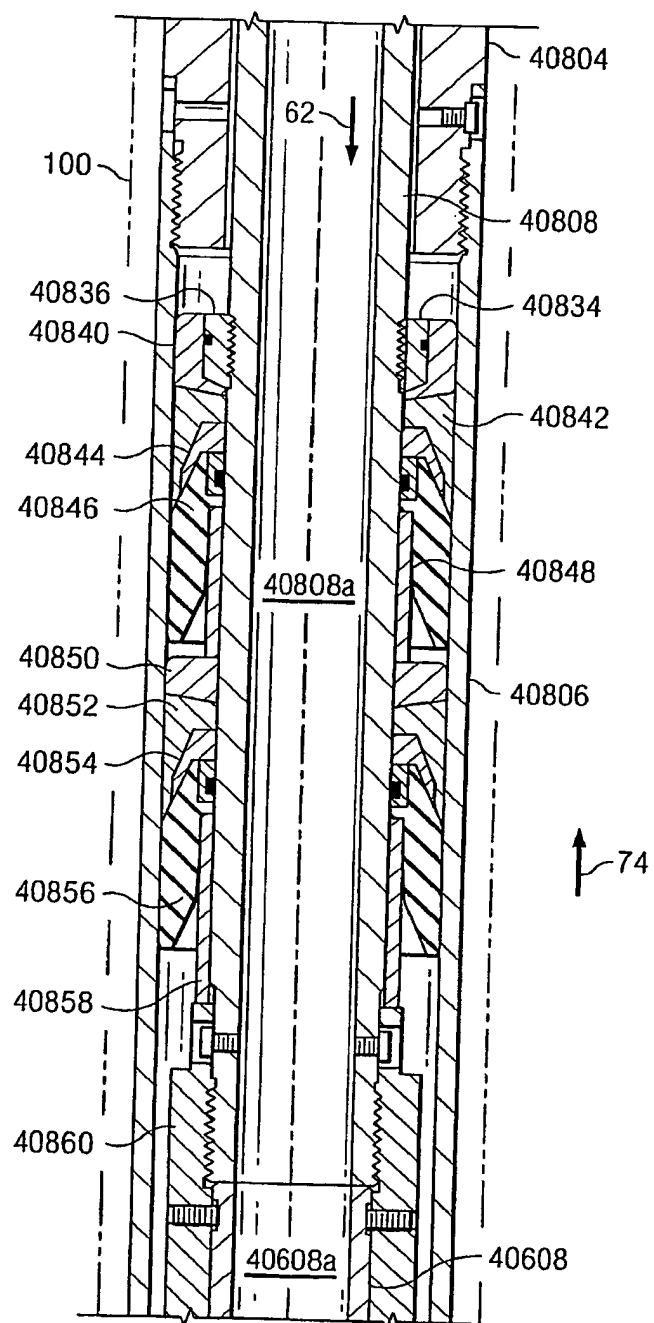


Fig. 41I

*Fig. 41J*

*Fig. 41K*

*Fig. 41L*

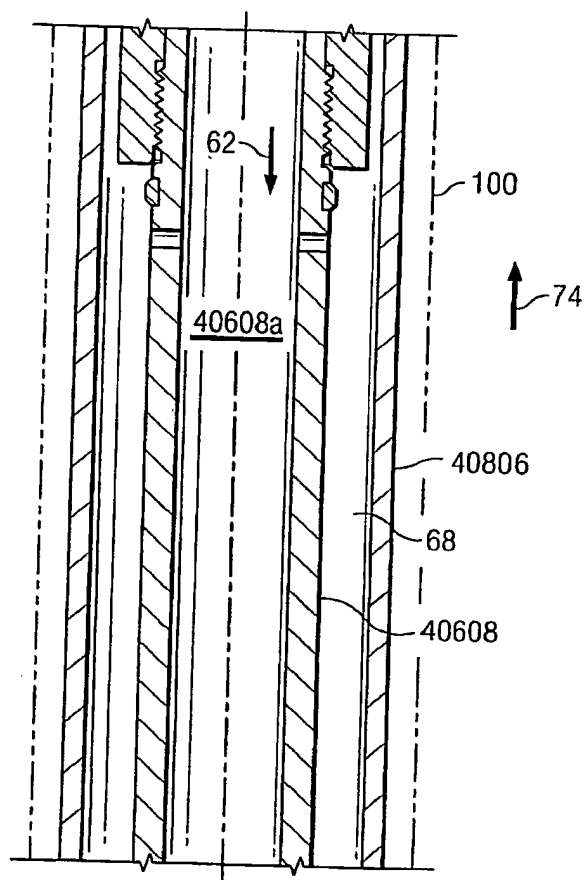


Fig. 41M

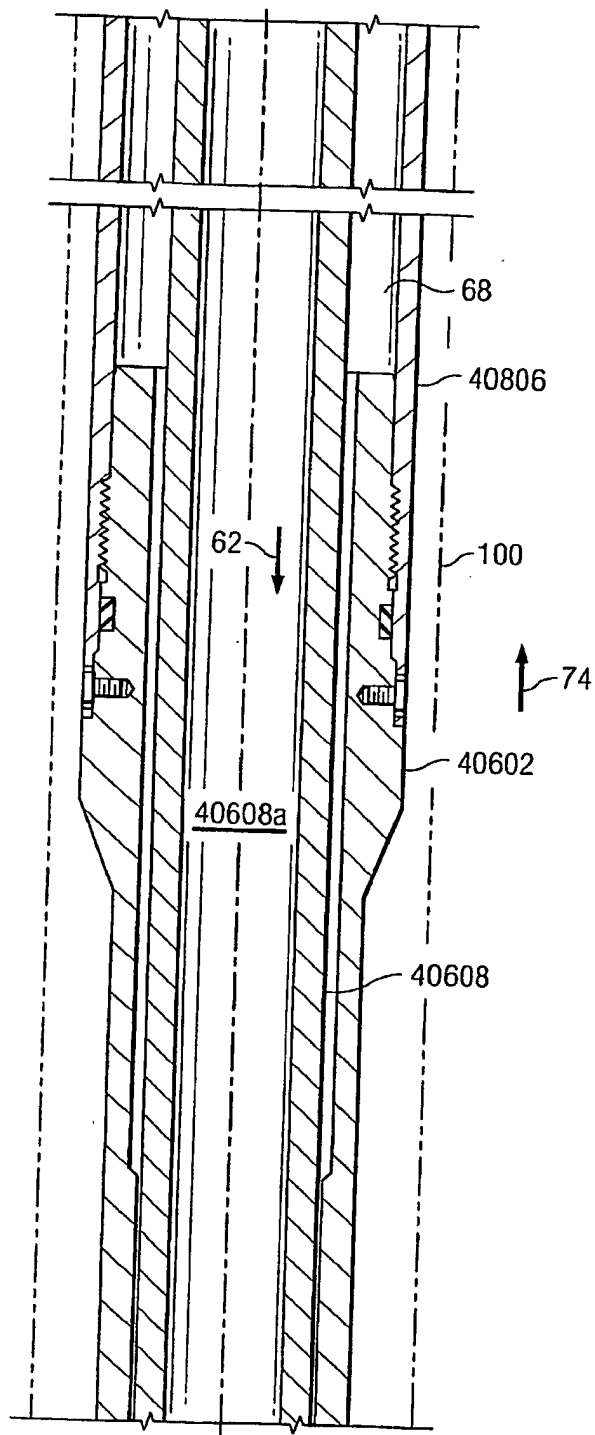
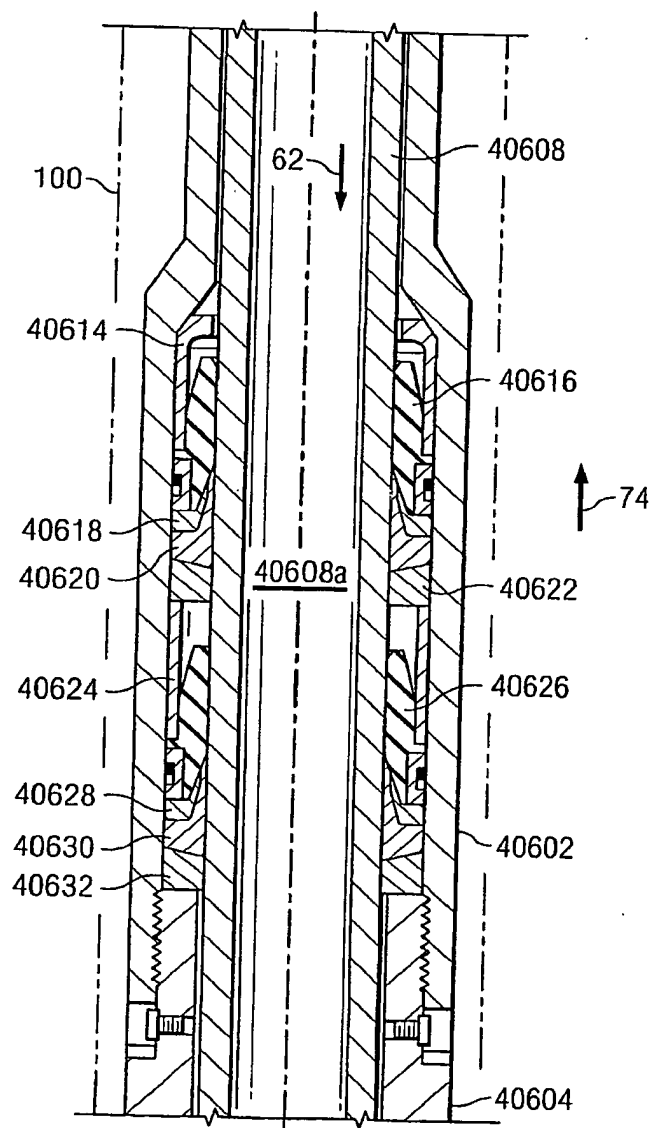
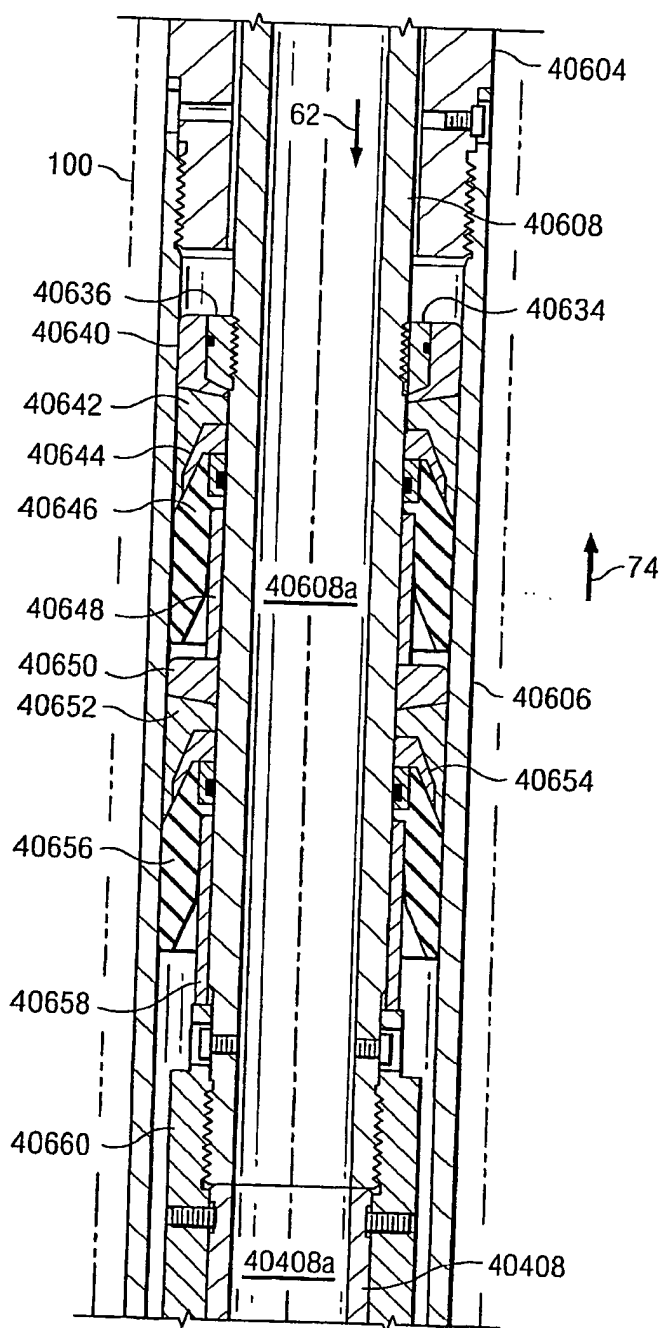
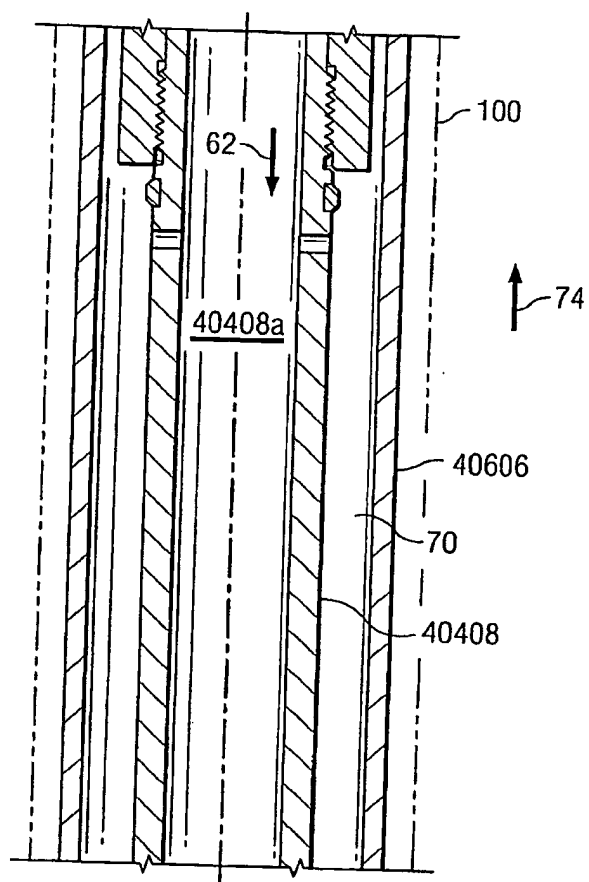
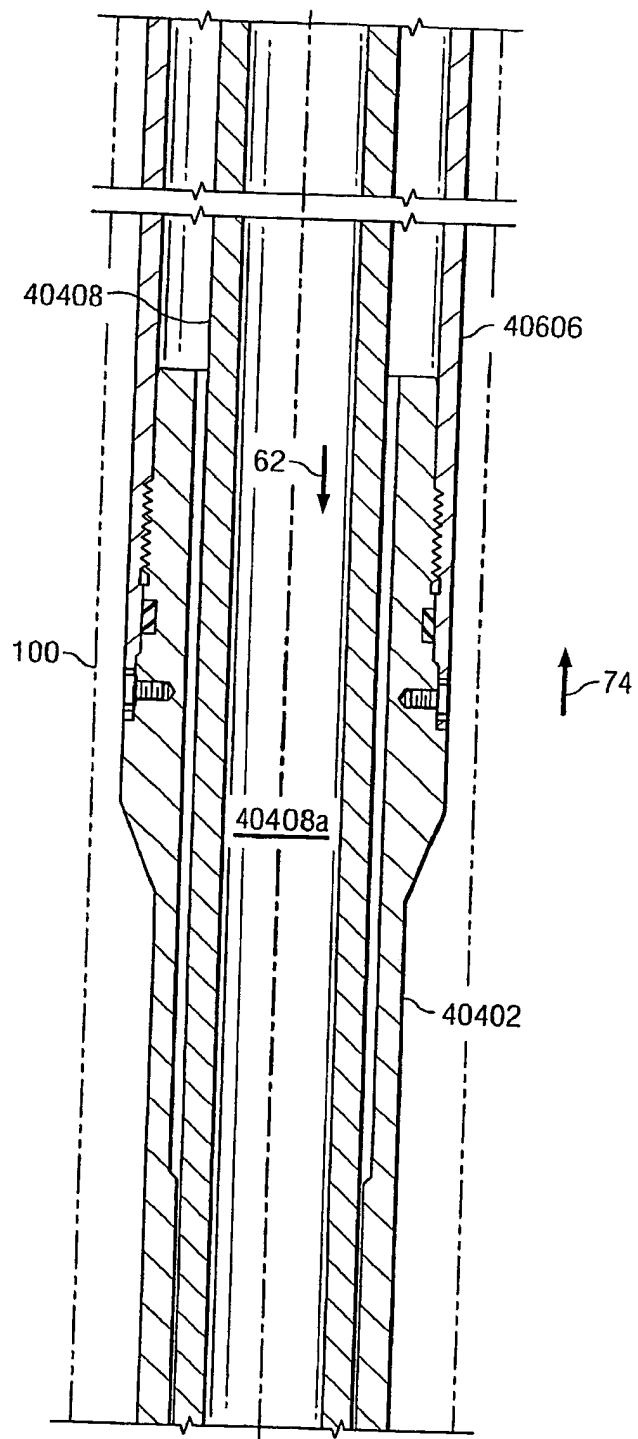


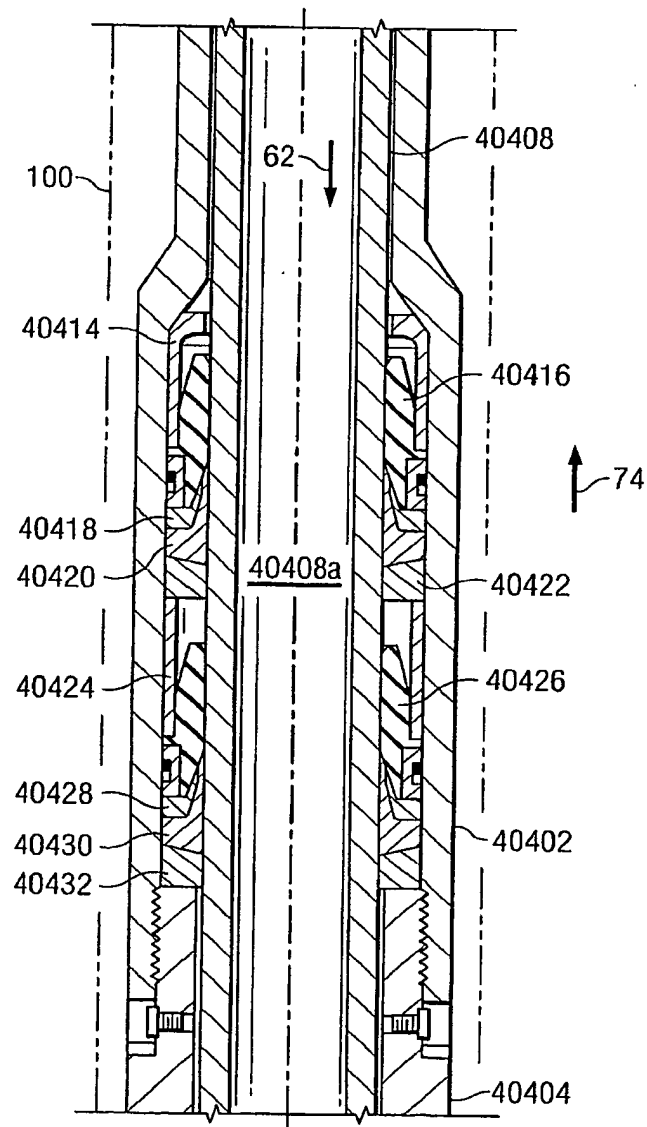
Fig. 41N

*Fig. 410*

*Fig. 41P*

*Fig. 41Q*

*Fig. 41R*

*Fig. 41S*

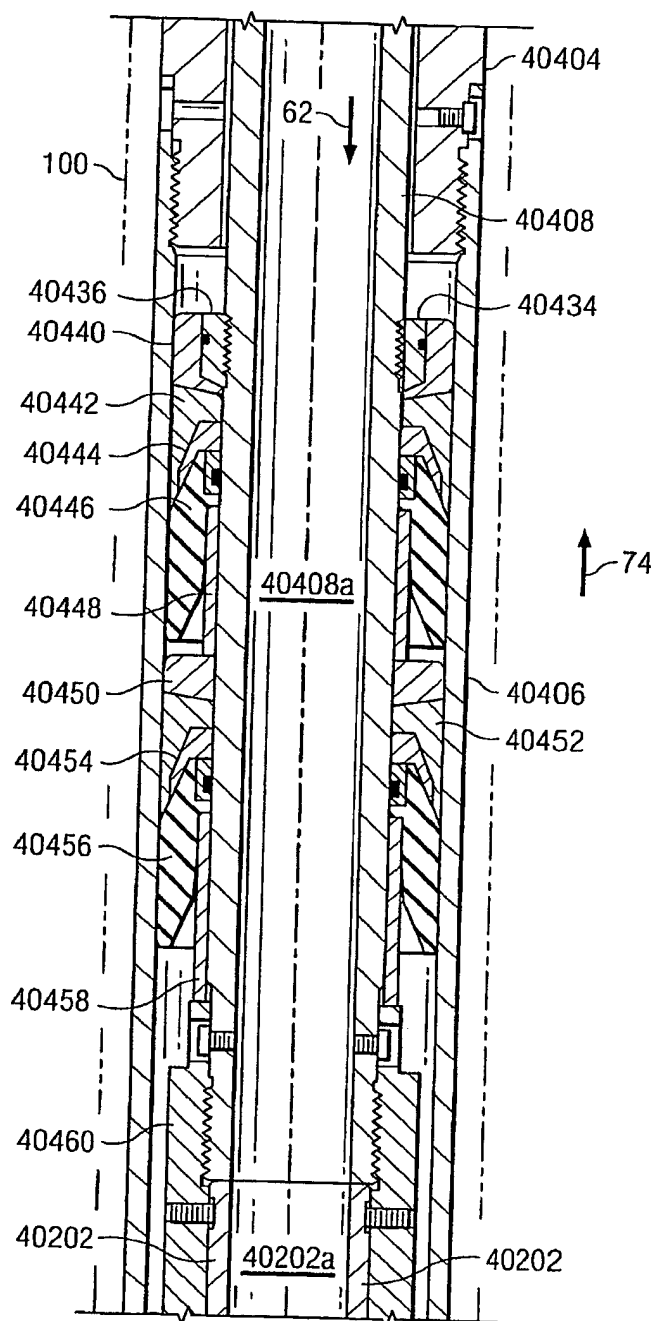


Fig. 41T

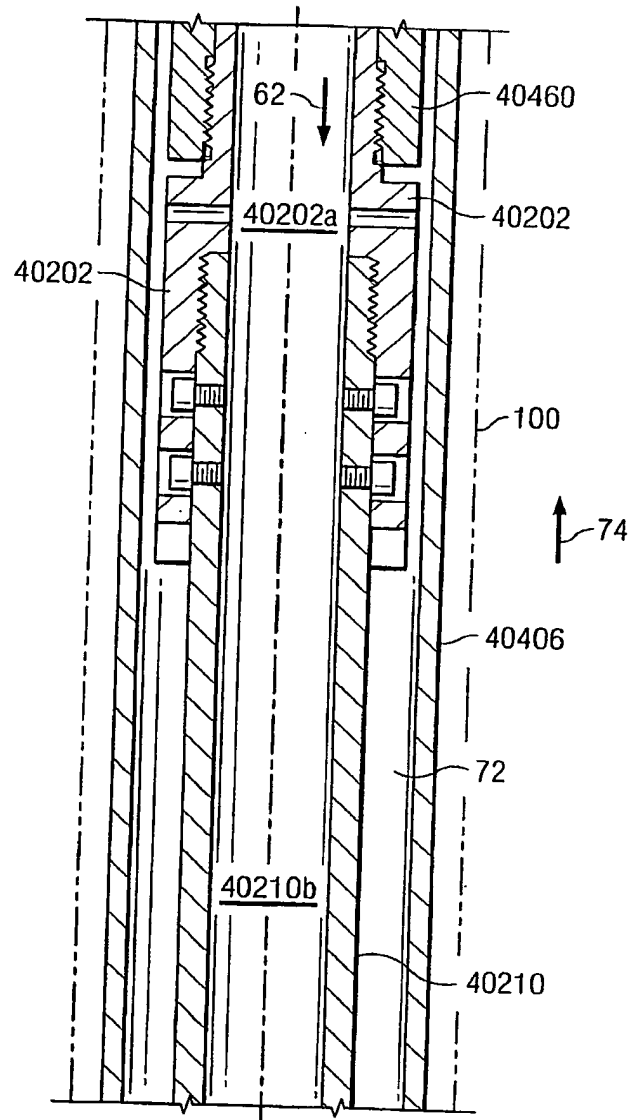
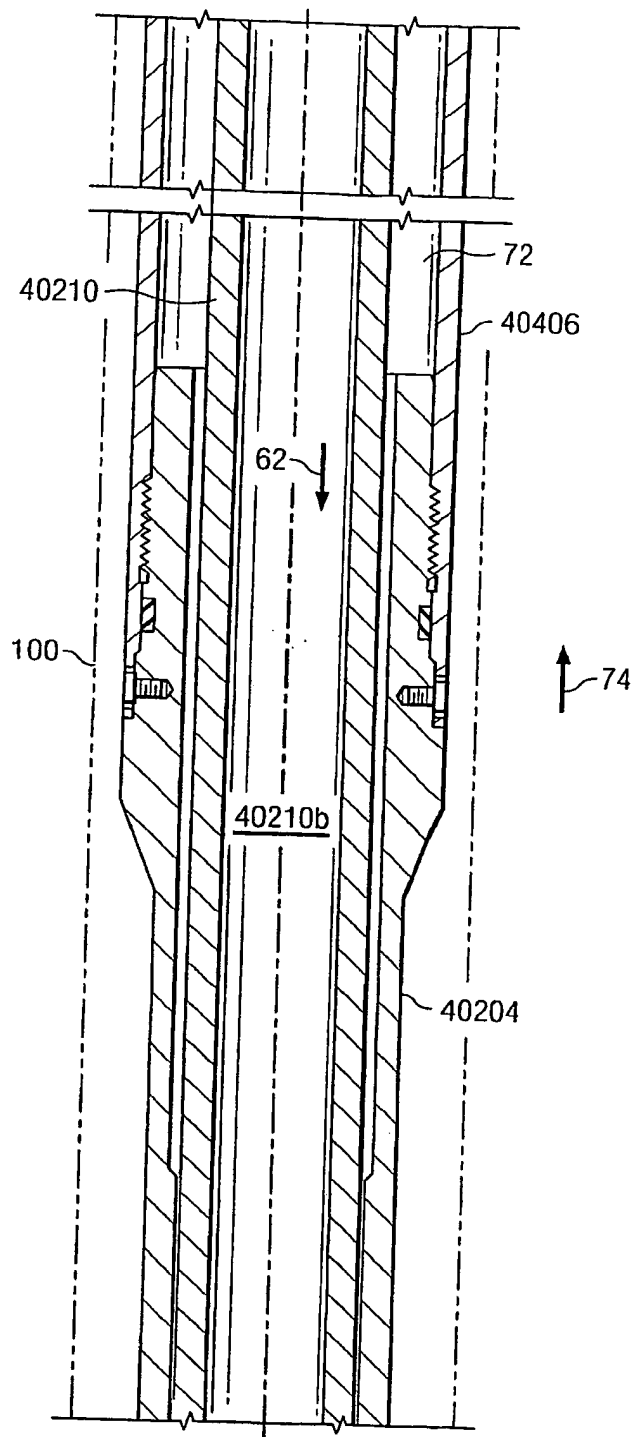
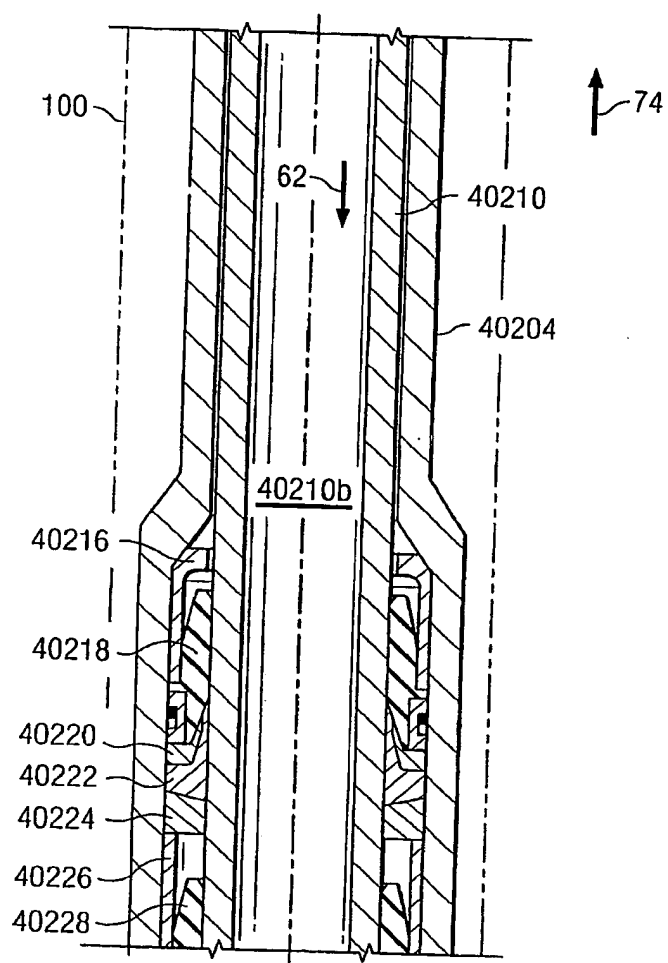
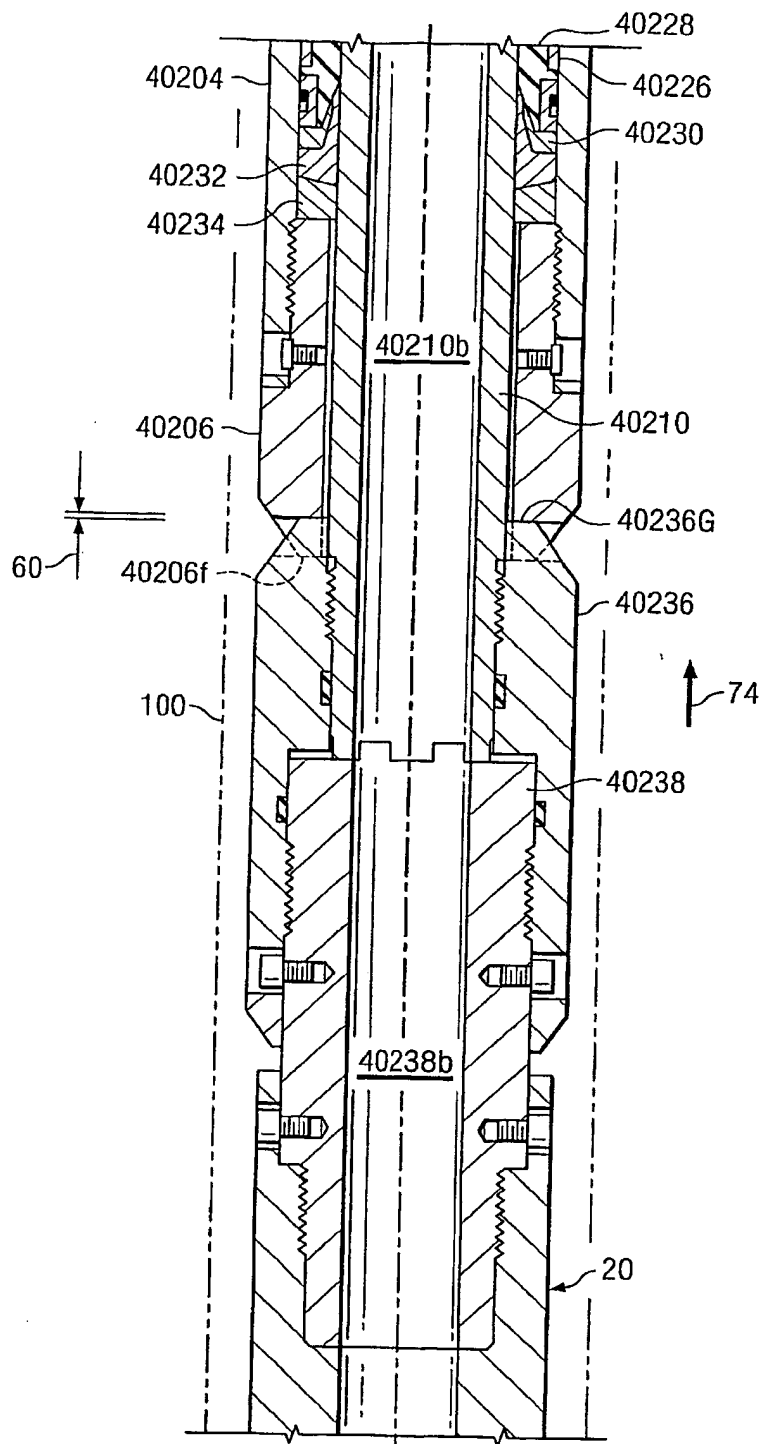
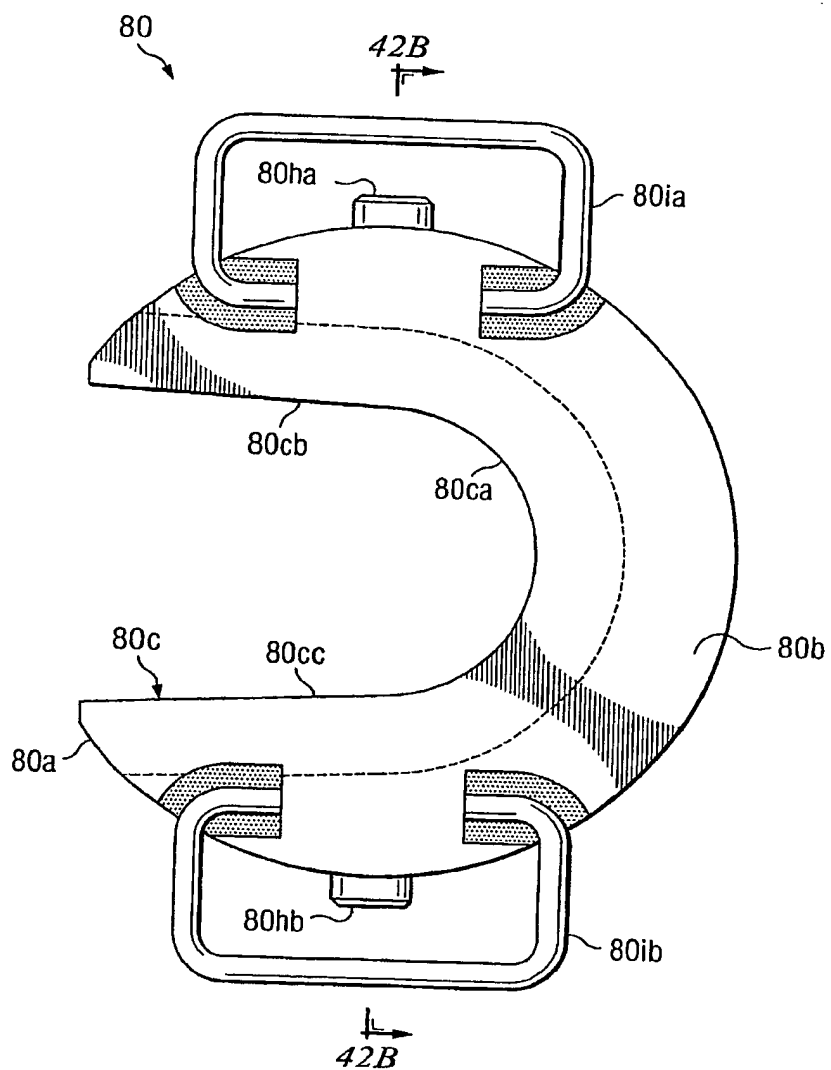


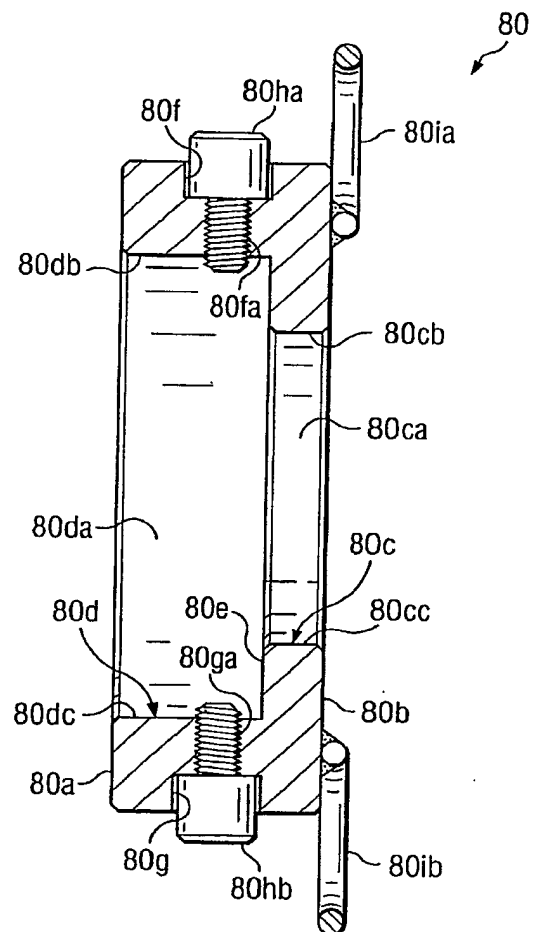
Fig. 41U

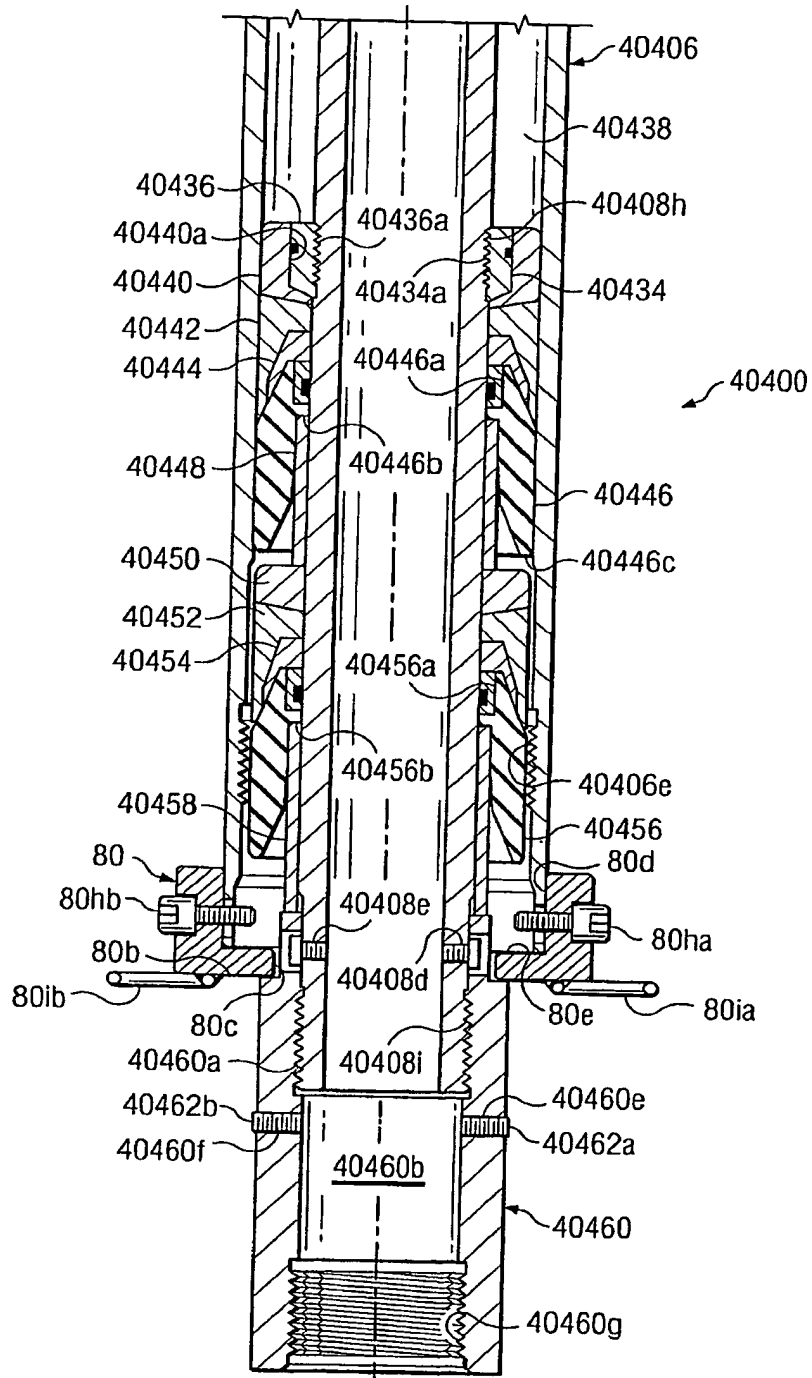
*Fig. 41V*

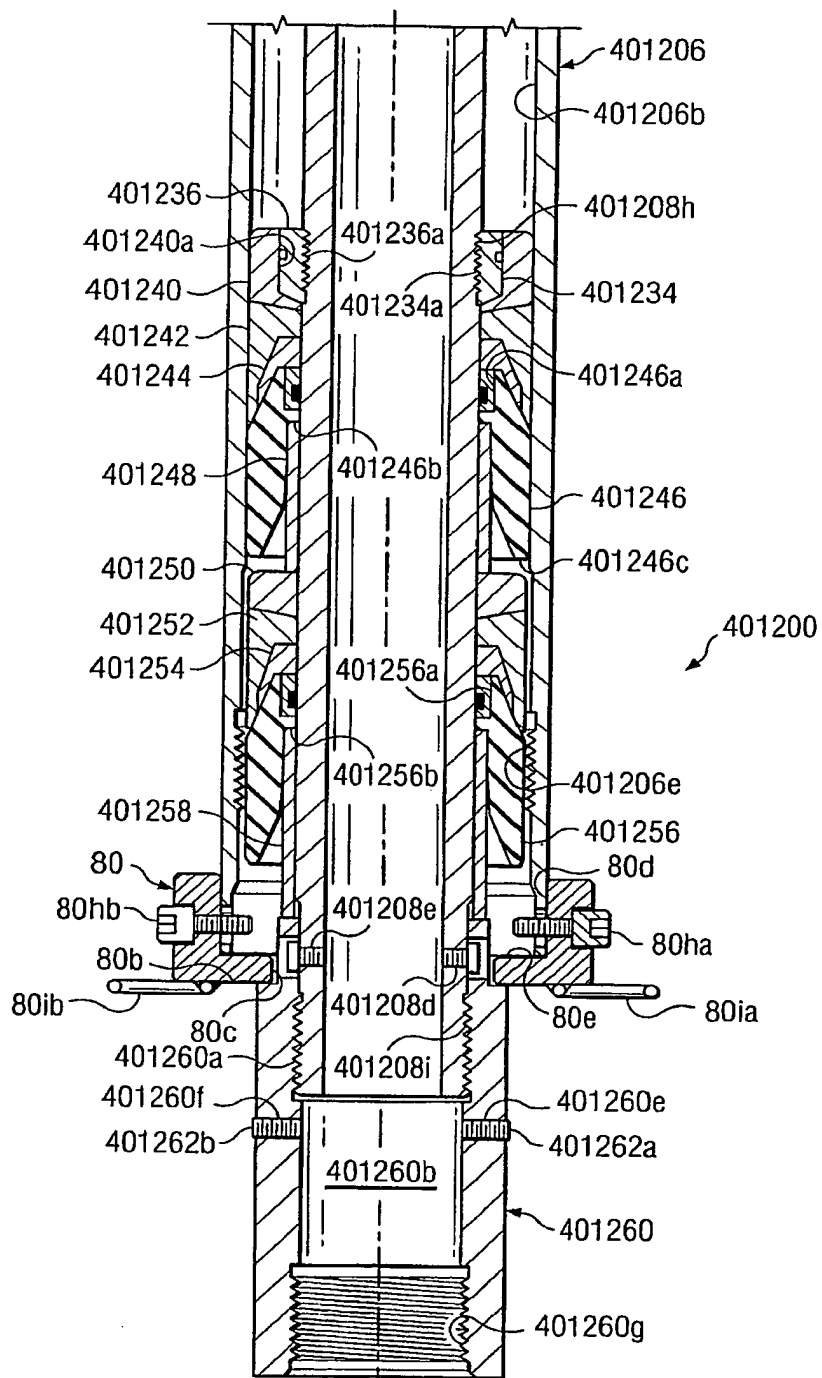
*Fig. 41W*

*Fig. 41X*

*Fig. 42A*

*Fig. 42B*

*Fig. 43*

*Fig. 44*